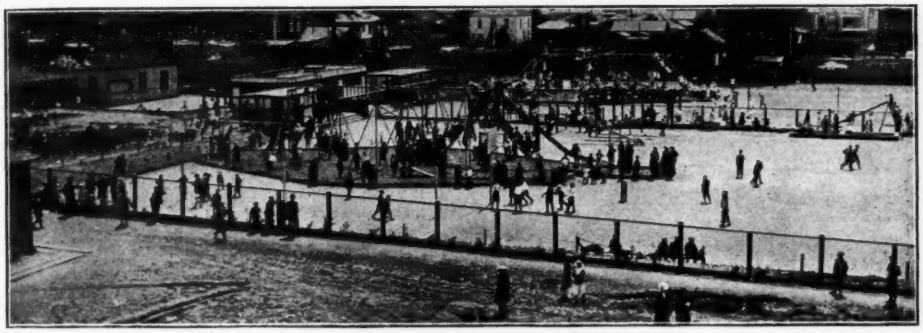
MUNICIPAL ENGINEERING

The World's Leading Municipal Publication.



PLAYGROUND *and equipment, Oakland, Cal.*

VOL. XLIV. MAY, 1913. No. 5.

Experience is one of the big assets which every man can place in his personal balance sheet. The successful man makes it show a profit. In these pages it is the endeavor of the publishers to give you of the experience of many men in your allied field of work and to thereby add something to your experience assets.

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Photo by Klein, Milwaukee Wis.

F. G. SIMMONS.

(See "Men Prominent in Municipal Affairs.")

COST OF ASPHALT REPAIRS

ASPHALT REPAIR PLANT *at Erie, Pa., designed by B. E. Briggs, City Engineer.*

SOME reports of the operation of municipal plants for the repair of streets for 1912 have been received and are abstracted in the following. Brooklyn accounts are kept in the utmost detail and the abstract below gives only the more noticeable items. The report from Erie is also quite full. Milwaukee uses the old material from the street and thus has quite a different report from any of the others. Winnipeg gives the totals without itemizing material, labor and overhead items. Others are held over for a following number.

A comparison of the figures from the various cities shows that they do not differ more than might be expected from the differences in cost of materials and labor.

Borough of Brooklyn, New York

The city of Brooklyn owns an asphalt paving plant which was built in 1907 by the Warren Brothers Company and is worth at this date $37,326.06, with improvements added and depreciation of 10 per cent. deducted. While the work which this plant does is much larger in amount than in the case of Dayton, O., concerning which an article was published in the February number of MUNICIPAL ENGINEERING, vol. xliv, p. 127, it is probable that the greater expense of doing work in the larger city offsets the reduction in average cost on account of keeping the plant more constantly in operation.

By courtesy of H. H. Schmidt, chief engineer of the bureau of highways of the borough of Brooklyn, New York, we have received an advance copy of the report of the asphalt repair department for 1912, and the following figures are taken from that report.

The force at the plant includes two foremen, two engineers, two stokers, two laborers and twenty asphalt workers, a total of twenty-eight. The force on the street works in seven gangs, each with a foreman, an engineer, fifteen asphalt workers and three trucks, with one truck missing and two asphalt workers short. This makes a street force of 137 men, or a total of 165 men.

The law requires the payment of a minimum wage of $2.50 a day, so that the laborers and practically all the asphalt workers are paid at this rate. The equivalent of one asphalt worker for 283 days received $3, which was paid stokers also. Nearly half the foremen's time was paid for at $4, the remainder and that of the engineers at $4.50. The superintendent's salary was $2,874.99 and his automobile cost $2,286.68 for maintenance.

The report gives the expenditures in the utmost detail of items. Unit or average unit costs of the more important items were as follows:

Refined asphalt, average, $15.94 per ton.

Binder stone, $1.25 a cubic yard, with a little at $1.10.

Cement, $1.02 a barrel, with a little at $1.10 and $1.18.

Coal, $2.015 per ton, mine weight, with some ranging from $1.92 to $2.62.

Fuel oil, 5 cents a gallon.

Residuum oil, 7½ and 8 cents a gallon.

Sand, 63⅞ cents a cubic yard with some at 51½ and some at 67½ cents.

Stone dust, $2.95 a ton, with a little at $3.05.

The summary of expenditures shows items which have the following totals:

Overhead, including superintendent's salary, depreciation, interest and rent	$ 11,490.96
General, including fuel, oil, automobile maintenance, dumping privilege, repairs to the plant and equipment, rent of Lutz surface heater, and office	26,168.74
Asphalt materials, including refined asphalt, residuum oil, stone dust and sand	48,792.98
Asphalt, residuum and stone for binder	8,517.05
Concrete materials	13.46
Special work materials	664.71
Plant labor, including foremen	17,668.72
Street labor, including foremen	81,939.44
Trucking	27,405.00
Total expenditures	$222,661.06

For this sum the following work was done:

Regular maintenance:
Wearing surface, 210,240.63 cu. ft.
Binder, 64,352.43 cu. ft.
Special maintenance with surface heater:
Wearing surface, 71,763.45 cu. ft.
Binder, 1,852.50 cu. ft.
Restoring street surfaces:
Wearing surface, 82,304.82 cu. ft.
Binder, 29,013.57 cu. ft.
Only 187.8 square yards of concrete foundation were laid.

Maintenance costs are computed per cubic foot of mixture used, with separate figures for wearing surface and binder. Supervision and fixed charges are distributed over the whole volume and amount to 2.6 cents per cubic foot. Materials cost 13.4 cents for wearing surface and 9 cents for binder. Other items are classified as regular maintenance and special repair with Lutz surface heater. Supplies, repairs, etc., cost 4.9 cents and 9 cents, respectively; plant labor, 4 and 3 cents; street labor, 18 and 9 cents; trucking, 5.7 and 3.8 cents per cubic foot, respectively.

The total cost per cubic foot for regular maintenance was 48.6 cents for wearing surface and 44.2 cents for binder; for surface heater work it was 40.8 and 36.4 cents, respectively. The total cost per cubic foot for both kinds of maintenance combined was as follows:

MAINTENANCE COST.

	Wearing surface cents cu. ft.	Binder cents cu. ft.
Supervision and fixed charges	2.6	2.6
Supplies, repairs, etc	6.1	5.2
Materials	13.4	9.0
Plant labor	3.7	3.9
Street labor	15.7	17.7
Trucking	5.2	5.6
Totals	46.7	44.0

Taking into account the amounts of each used, the average cost of binder and wearing surface is 47.6 cents a cubic foot. These maintenance costs are subdivided in great detail as to each item in the report.

The cost of restoring openings made in street surfaces and repaving is analyzed separately. The total cost of restoring the 111,318.39 cubic feet of wearing surface and binder, above named, was $57,602.73. The costs per cubic foot itemized were as follows:

RESTORATION COST.

	Wearing surface cents cu. ft.	Binder cents cu. ft.
Supervision and fixed charges	2.4	2.4
Supplies, repairs, etc	4.9	4.9
Materials	13.4	9.0
Plant labor	4.0	4.0
Street labor	19.8	19.8
Trucking	8.1	8.1
Totals	52.6	48.2

These figures do not differ materially from those for maintenance cost, except that street labor and trucking are materially higher.

All the above figures are per cubic foot of material used. No statement is made of the area of repairs actually made, but the amount of pavement restored is given as 46,537.4 square yards. This makes the cost per square yard for restoring and repairing, $1.231, without concrete. Of this 93.1 cents is for wearing surface and 30 cents is for binder.

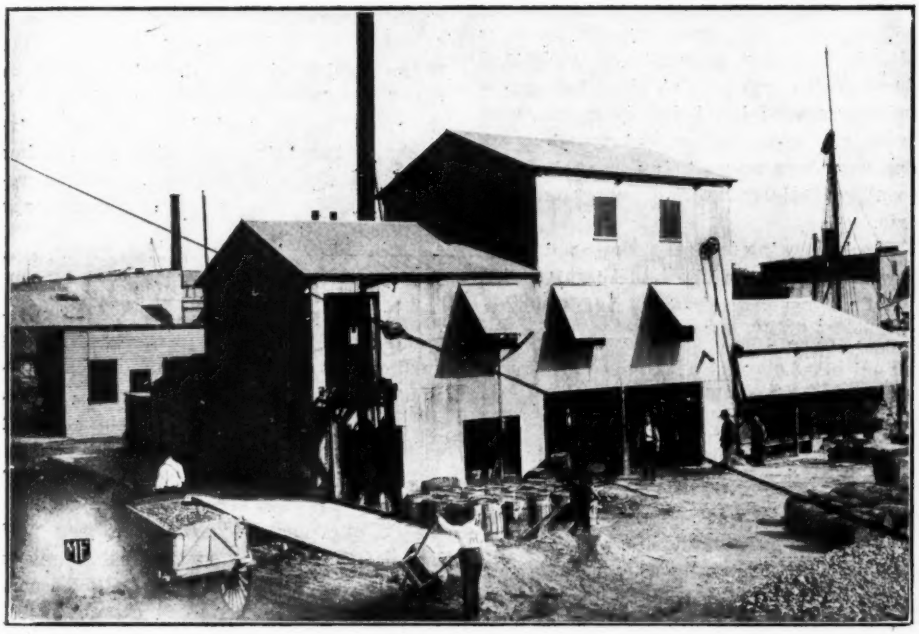
The thickness of repairs is not estimated. If we assume that the average

thickness of repairs is two inches, the assumption will not be unreasonable, for the thickness of new wearing surface is two inches, and the amount of binder used in repairs is more than one-fourth the amount of wearing surface material used.

On this assumption, the 47.6 cents per cubic foot average cost of binder and wearing surface is equivalent to 71.4 cents per square yard of asphalt actually laid in repairs. It checks reasonably well with the cost of restoration given above, $1.231, assuming the thickness of the binder to be 1½ inches.

An area of 21,857 square yards was resurfaced with skim coat by the Lutz heater and 38,394 square yards with the Iroquois heaters, a total of 60,251 square yards. The item of materials is 1½ to 3½ cents a yard higher than that for wearing surface in the tables above, but labor and trucking items are less. The total costs are for the Lutz heater, 53.7 cents a square yard, and for the Iroquois heaters, 47.4 cents a square yard. Deducting 10 cents a square yard charged for rental of the Lutz heater makes the cost of repairs with it 43.7 cents. The cost of all the work with both heaters averaged 49.6 cents a square yard, including the rental of the Lutz heater. The number of cubic feet of paving material laid was 73,616, so that the average thickness of the work was 1.62 inches, an indication that the assumption of 2 inches total thickness of regular maintenance is not far wrong.

Cost of repaving without foundation, done by contract, was 82 cents to 90.7 cents a square yard in 1910 and 1911.



MUNICIPAL ASPHALT PLANT *at Brooklyn, N. Y., built by Warren Bros. Company.*

Erie, Pa.

The city of Erie, Pa., Ben. E. Briggs, city engineer, has operated its new asphalt repair plant for about a year with excellent results. The plant cost $12,360 and 10 per cent. of this sum was charged to operating expenses for interest and depreciation. Labor and teaming cost $5,602.20, including foreman, and materials cost $7,495.73. Nothing is charged for city engineer's time. The city owns the asphalt wagons, but hires teams to haul them. It is claimed that a considerable saving could be made if the city owned a number of teams.

With this amount of material and labor a total of 21,476.34 square yards of top

and binder were laid, each 1.5 inches thick, or a total of 3 inches. This makes the average cost per square yard 68 cents, made up of the following items, divided as nearly as possible according to the Brooklyn plan:

	Cents
Supervision, (0), fixed charges and repairs	7.0
Materials	34.9
Plant and street labor	19.5
Teaming	6.6
Total	68.0

The total cost per square yard is slightly less that in Brooklyn, estimated above at 71.4 cents. The plant being new and no supervision being charged, these items are less. Labor and teaming are also less, days wages being less. But material, especially asphalt, cost more in Erie.

The following prices compared with those for Brooklyn show the detail.

Refined asphalt, $20.50 to $24 a ton.
Crushed stone, $62.50 a car.
Coal, $3.22 a ton.
Fuel oil, 3.9 cents a gallon.
Flux oil, 3.8 cents a gallon.
Sand, $31 a car.
Stone dust, $3 a ton.

The Erie plant did 4,161.88 yards of work for corporations and various city departments in repairing cuts in pavements, etc., for which it received $1 a square yard. Deducting this yardage and credit from the corresponding figures above, the actual cost to the plant of work done for the city is 60.3 cents a square yard.

Milwaukee, Wis.

Frank W. Blodgett, superintendent of street construction, Milwaukee, Wis., reports as follows:

"We have in Milwaukee, one stationary repair plant which we are rebuilding this winter, and expect to output from this plant about 2,500 square yards of asphalt. We have also two portable repair plants, eah one with a capacity of about 125 square yards.

" These plants are designed to melt up the old material. This old material having been melted and freshened with a small amount of asphaltic cement, is then used for repairing purposes.

"The cost of repairs for the past year, which is the only year in which any record has been kept, averages about 85c per square yard. This includes the cost of new work, which was done at the price of about 26c per square yard. The same material was used in the laying of new pavements as was used in the repairing of old pavements.

"The small portable asphalt repair plants cost us $1,500.00 each. The large plant costs us originally $5,000.00, to which will have to be added the cost of rebuilding, which will amount to about $1,500.00. I desire to say, however, that if the stationary plant had been built in the first place as we are rebuilding it, the cost would probably not have exceeded $4,000.00; the rebuilding being made necessary by defective heating apparatus. As the plant originally was constructed it was practically impossible to turn out a batch of asphalt in less than forty-five (45) minutes.

"Our contracts for resurfacing old pavements with asphalt require that the old surface be delivered to us at our stationary plant by the contractors, which accounts in some measure for the low cost of the repair work.

"The material as remelted and placed upon the street is superior to the generality of new asphalt pavements and will last at least as long and probably longer than any of the pavements laid by contract.

"We are at the present time proposing to do away with the two small portable plants, providing the stationary plant delivers the material to the amount that we hope that it will do after we rebuild it, as we find we can mix the material at the stationary plant and haul it three miles and put it upon the street, cheaper than we can by the use of the two small portable plants."

Winnipeg, Man.

C. S. Landon, superintendent of the asphalting department of the city of Winnipeg, Canada, makes the following report:

The cost per square yard of each kind of asphalt pavement laid includes the cost of material, unloading, insurance, etc., plant labor, street labor, the cost of

hauling, and the cost of fuel and does not include grading and concrete base.

In Winnipeg during the past few years it has been the custom to lay 4½ inches of concrete on residence streets, and 6 inches of concrete on business and other heavy traffic streets. It is the intention now, however, to lay not less than 6 inches on any street, the difference being made up by lessening the thickness of the binder and surface courses of residence streets.

It might be of interest to know that this city began laying its own pavements in the year 1899. During that time nine different brands of asphalts have been used at prices ranging from $40 a ton in the year 1899 to $21.65 per ton in the year that has just passed.

SUMMARY OF COSTS

Granite sheet asphalt, 1½ inch binder, 2 inch surface, $1.044 per sq. yd.

Standard sheet asphalt, 1½ inch binder, 2 inch surface, $0.981 per sq. yd.

Granite sheet asphalt, 1 inch binder, 1 inch surface, $0.677 per sq. yd.

Standard sheet asphalt, 1 inch binder, 1 inch surface, $0.644 per sq. yd.

Asphaltic concrete, 2 inch granite, $0.605 per sq. yd.

Bituminous concrete, 1 inch binder, 1 inch bit. con. granite, $0.561 per sq. yd.

Cross mixture, 1½ inch binder, ½ inch surface, $0.558 per sq. yd.

Asphaltic concrete, 2 inch limestone, $0.517 per sq. yd.

In the granite sheet asphalt a percentage of the aggregate is replaced by an equal amount of granite screenings ranging in fineness from ⅜ inch to dust.

The constituent parts of the cross mixture are identically the same as those in the standard sheet asphalt.

The concretes as shown differ but little in composition and where granite is cited it means that this kind of rock is used as a part instead of limestone.

The costs of materials during the year 1912 were.

Limestone, crushed.....	$ 1.25 a cu. yard
Granite	3.50 a cu. yard
Sand (coarse and fine).	1.10 a cu. yard
Limestone dust	.65 a cu. yard
Asphalt	21.65 per ton

SAN MATEO COUNTY, CAL., HIGHWAYS

By R. M. Morton, Chief Engineer.

The system of roads outlined for San Mateo county contemplates fifty to sixty miles of roadway with concrete base and fifty miles of gravel or macadam. The latter type is to be used only in locations where natural material is available at low cost.

This system, together with the twenty miles of state highway, will give San Mateo county the best system of roads in the state. Surveyor Neuman has secured most of the forty miles of right of way necessary for the completion of the system contemplated under the bond issue.

We have planned all these roads for a maximum grade of 5 per cent. except on those where the travel is light and then the grade is a maximum of 6 per cent. This will be the only county in the state where such a system could possibly be constructed at the present time, for the reason that no other county is in such a financial condition as to be able to take care of all the main roads in the county.

The cheaper forms of material (gravel and macadam) have been subordinated, as they have been found not to pay except where the natural material can be found in sufficient quantities to maintain the roads at a low cost. Concrete with asphaltic surface is known to be the bost economical and permanent road, and these have been prescribed where conditions of traffic warrant.

SEWER SIPHONS UNDER NEW YORK SUBWAY

By Thad. L. Wilson, before the Brooklyn Engineers' Club.

The building of subways necessitates material changes in the location of existing sewers along the line of the subway. Generally the sewers can be passed either above or below the subway structure by altering the general gradient of the sewer, or by rebuilding the sewer at a considerably lower level than before, either of which is a simple operation. It sometimes happens that the existing sewer has its invert elevation at or below high tide level and the subway structure lies in the same horizontal plane. Then, it being impracticable to raise the sewer, it is necessary to lower it, thus making a radical break in the original gradient and resulting in an inverted siphon.

To avoid these inverted siphons it would be necessary to make the subway the dividing line between drainage areas, or else to lower the subway sufficiently to allow the sewer to pass over the roof. To effect the former, it would be necessary to replace the existing sewers over a large area at a cost which has generally been considered prohibitory. To lower the subway sufficiently to allow the sewer to pass over it would add greatly to the cost of construction, besides in some instances, inconvenience to the public in requiring the station platforms to be built at an unusual depth below the street surface, or changing the location of the station.

Conditions admittedly requiring a siphon were first encountered in 1902 during the construction of the old subway in the Bronx, at 149th Street and Railroad Avenue, north of the Mott Avenue Station. The old sewer in Railroad Avenue 5 feet circular, has its invert elevation about 2 feet below mean high tide. To pass this sewer under the subway it was necessary to lower it about 10 feet.

Mr. E. W. Clarke, C. E., was in charge of sewer work on this section of the subway at the time, under the Rapid Transit Commission, and designed and supervised the construction of this first siphon. It should be said that it was by his persistent and convincing argument and faith in his design that its construction was finally authorized, against much opposition. Gaging and velocity tests by floats were taken by Clarke at night at low tide and it was found that a 14-inch iron pipe would carry the normal flow at a velocity sufficient, it was believed, to keep this pipe free from accumulated sediment. Two 42-inch storm water pipes were provided on either side of the small pipe, calculated to have capacity equal to the old sewer when running full.

This siphon was put in commission in the early winter of 1903, and has since been performing its functions satisfactorily. In passing judgment upon the efficiency of this siphon it should be borne in mind that it has worked as intended for the past ten years without additional cost to the Borough for maintenance.

In Brooklyn on the Fourth Avenue Route siphons have been built at Hudson Avenue and Fulton Street, Dean Street and Fourth Avenue and at Butler Street and at 35th street.

The Hudson Avenue siphon connects a 4.5 feet by 3 feet egg shaped sewer at an elevation of 10 feet above high tide, the drop being 22 feet to pass below the subway. A 10-inch pipe is provided for the normal flow and a 24-inch pipe for the storm water. The discharge end being at an elevation sufficient to eliminate all tidal effect, this siphon has a great advantage over those at or below tide water level. As a relief in case of emergency a 14-inch by 4 feet conduit, built in the roof, passes transversely across the subway at an elevation 4 feet above the invert of the sewer.

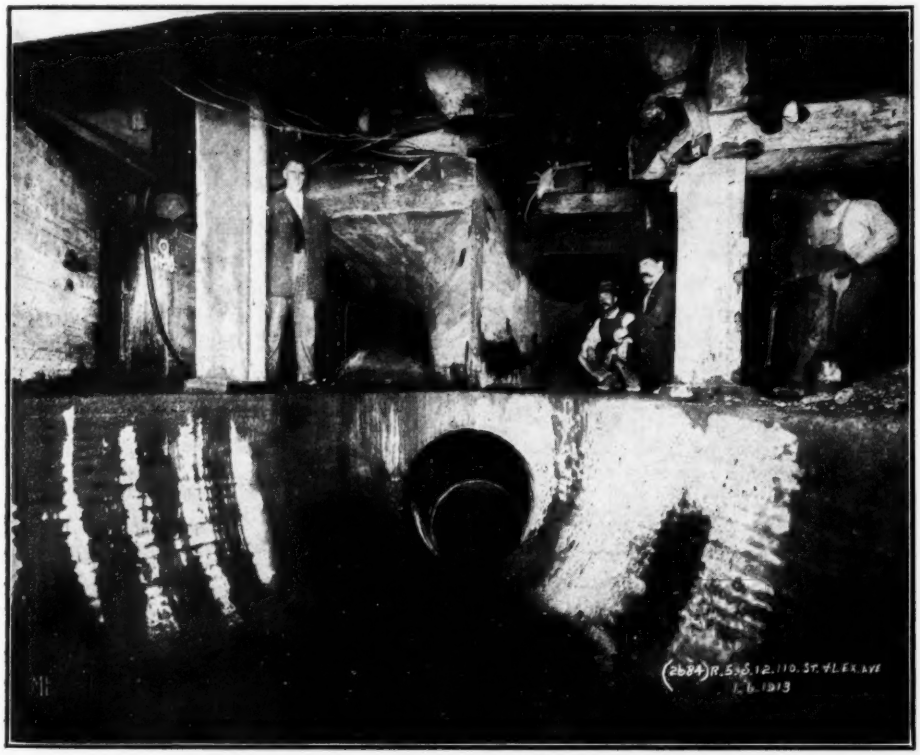
The Dean Street siphon connects a 6-foot circular sewer, the drop being 14 feet

and the discharge end of the siphon being 12 feet above high tide. This siphon is working well and will probably prove one of the most satisfactory built. An 18-inch cast iron pipe carries the normal flow at a good velocity. Two 48-inch pipes are provided for storm water.

Resort to siphons seems to the writer inadvisable unless the volume of sewage is sufficient to effect a minimum velocity of 2 feet per second in a 12-inch pipe.

The construction of the Lexington Avenue subway required siphons at 106th and 110th Streets, the former serving a drainage area of 109 acres with an estimated maximum run off of 250 cubic feet per second and a minimum of 9 cubic feet and the latter an area of 227 acres with a maximum of 356 cubic feet per second and a minimum of 29 cubic feet.

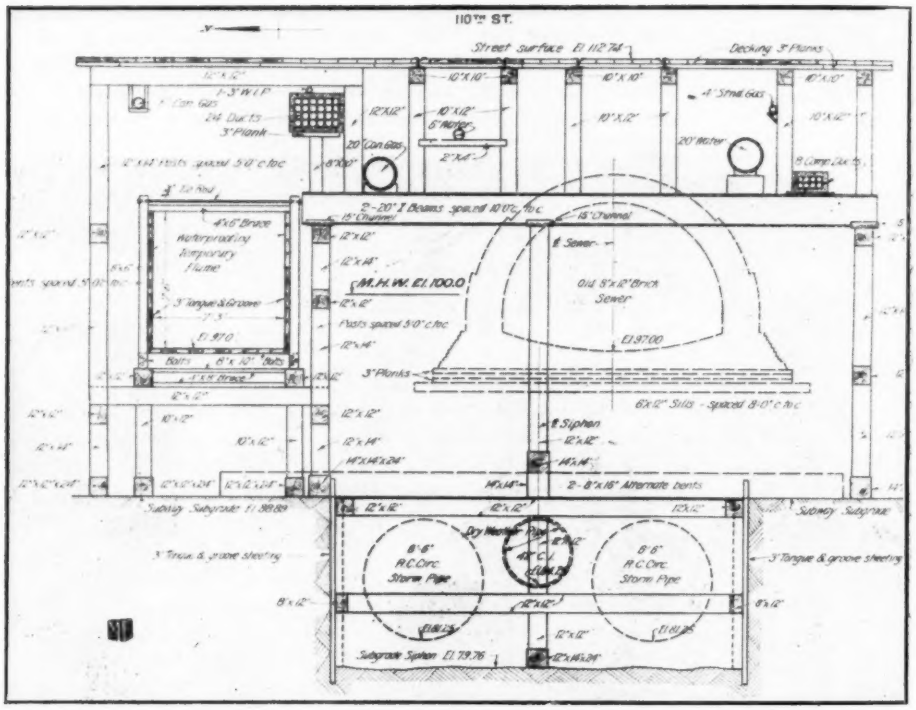
To avoid these siphons it would have been necessary to lower the base of rail in the subway 12 feet to allow the sewers to pass over the roof, or to build a trunk sewer in Park Avenue from 110th Street south to 96th Street and thence east in 86th Street to the East River. To lower the subway for about eight city blocks would have added to the cost of construction probably a million dollars and necessitated the placing of the station platforms at an inconvenient depth below the surface of the street, or changing the location of the stations to points off from the main lines of cross-town travel. To build a new sewer in Park Avenue and 96th Street with the necessary laterals would have cost probably over a million and a half of dollars, which was considered prohibitory.



INTAKE CHAMBER *nearing completion, showing 42-inch cast iron pipe below and inlets to the two 6.5-foot reinforced concrete storm water pipes above, which rise on the opposite side of the subway to a similar outlet chamber and discharge thence again into the sewer, which is largely below level of high tide.*

It was the intent in designing these siphons to make the dams controlling the flow through the dry weather pipes at an elevation a little above mean high tide,

thus confining the entire normal flow to the smaller pipes and obtaining in them the greatest average velocity without raising the water in the sewer up stream from the siphons higher than it had been rising previously at high tide. This is the material difference in design from the Railroad Avenue siphon previously referred to. In the Railroad Avenue siphon all pipes are submerged and obtain some



TIMBERING *for excavation for inverted siphon at Lexington Ave. and One Hundred and Tenth St., showing excavation below subway for siphon pipes, the temporary flume for carrying sewage during construction, the cross-section of the sewer cut by the subway and joined by the siphon pipes, and the method of carrying water and gas pipes and conduits across the excavation.*

velocity twice daily, while these siphons rarely take storm water in the larger pipes except during storm at high tide, the dry weather pipe being adequate to carry an ordinary rain storm, at ebb or low tide obtaining of course great velocity.

Another feature introduced with these siphons is the by-pass to facilitate cleaning the dry weather pipe should it become necessary. See horizontal section in accompanying plan. This consists of a circular conduit of the diameter of the small pipe and passing from the chamber on a level with the invert of the sewer, through the dam and into one of the storm water pipes at each end of the siphon. A sluice gate in each chamber when closed renders the passageway inoperative, but by opening the gates the flow freely passes into the storm water pipe to the full capacity of the dry weather pipe. A temporary dam of sandbags easily constructed across the chamber between the end of the dry weather pipe and the by-pass conduit in each chamber will allow all the flow to pass through the storm pipe, thus rendering the dry weather pipe inoperative, without raising the water in the sewer. This appears to be the only device so far that will prove really helpful in cleaning the small pipe. Another use to which this device could be put would be to open these gates in time of storm, thus doubling the capacity of the dry weather pipe and securing a velocity in the storm pipe suffi-

cient to keep it open, if not free from sediment, besides holding the water in the sewer during storms to the same level as prevailed before the siphons were built. It would require a storm of unusual intensity to overtax these two pipes except at high tide. Study along this line may lead to further improvement in design.

These siphons are provided with clean-out manholes for the small pipes at each side of the subway structure, entrance to the pipes from the bottom of the manholes to be obtained by removing the upper part of the pipe. The pipe at these manholes being special castings, the flanges milled and bolted together, lead gaskets being used. The construction of these manholes was the most annoying part of the work and they are of doubtful utility.

The 106th Street siphon connects a 5.25-foot circular sewer the invert of which is 2 feet below mean high tide and has a drop of 14 feet. This siphon as also the one at 110th street was built by the Oscar Daniels Co., contractor for section 12 of the Lexington Avenue subway, during the summer and fall of 1912. The construction was carried out according to plan and without incident. The flow during construction was carried in a wooden flume 6 feet deep and 5 feet wide. Excavation below the subgrade of the subway was in clay practically impervious.

The 110th Street siphon having a drop of 16 feet connects a horseshoe shaped sewer 12 feet wide by 8 feet deep with a flow line elevation 3 feet below mean high tide. The old sewer was built of brick upon timber grillage, consisting of two courses of 4 inch by 8 inch spruce crossed diagonally. Cross section is shown in the drawing, showing system of timbering used in the excavation and the temporary flume for carrying sewage during construction of the new work. The material excavated below the subway was sand and clay, very wet. For about half the distance across the subway, rock was encountered for about 2 feet depth above subgrade.

A wooden flume 7 feet wide by 6.5 feet deep was first built north of the siphon trench which carried the flow during construction without overflowing. It may be of interest to note that the highest point to which the water in the sewer has risen since the beginning of this work was 3 feet 6 inches above mean high tide or 6.5 feet above the flow line. This was at night during high tide and a violent rain storm, the water rising in the flume to within 4 inches of overflowing.

This siphon has a 42-inch cast iron pipe for the normal flow and two reinforced concrete circular pipes 6.5 feet inner diameter, and required a trench 22 feet wide.

As the excavation progressed a sump was carried down outside the sheeting to a depth of 4 feet below subgrade, from which a 6-inch centrifugal pump, electrically driven, controlled the water. 24-in. I-beams, 32 feet long were placed across the siphon trench 10 feet apart and doubled under roadway of Lexington Avenue, strongly supported at each end outside the trench, and by posting in the center. These I-beams carried the surface and subsurface loads, giving room for bracing and sheeting the trench below the subgrade of the subway in the usual way without difficulty. Three-inch tongue and groove sheeting was used, the timbers being generally 12 inches by 12 inches. When the excavation was completed, 6 inches to 8 inches of concrete was placed in the bottom and banked somewhat on the sides to hold the toe of the sheeting as well as to afford a solid working floor. The reinforcing rods were then assembled, wired and supported in place, and inside of these the forms were placed and concrete was poured. Collapsible steel forms were used. The 42-inch pipe was then set and calked, after which the centers, the same forms as used for invert, were placed, the remaining reinforcing rods assembled, and the remainder of concrete poured. The accompanying photograph shows the chamber at one end of the siphons near completion.

On September 22d, 1912, water was turned into the 106th Street siphon and on December 7th into the 110th Street siphon, since which time each has been working satisfactorily.

Efforts have been made from time to time to obtain authoritative information of velocities and tidal effect, but as yet our data are too meager to warrant any

conclusions at 106th Street, except to satisfy ourselves that this siphon has not resulted in raising the water in the sewer above the siphon to any appreciable extent at any time of tide or during storms.

At 110th Street observations have been carried on more thoroughly, and of late systematically, which if pursued for a sufficient length of time may give data of value.

On February 22d occurred the highest tide that has been observed since the siphon was put in operation, the water rising to an elevation of 1.82 feet above mean high tide and reaching the same elevation in the chambers at each end of the siphon. At this time temporary dams had been built upon the permanent dams to an elevation above the water level this day, so that no water entered the storm pipes. It would be very interesting to know just what was happening in the 42-inch pipe at this time when the surface elevation at each end was the same. There appeared to be velocity down stream from surface indications. Proof of this is lacking, but the instant the tide began to subside there was no uncertainty, and the volume of water carried through this 42-inch pipe was obviously enormous.

On February 21st, time of high tide being 9:55 a. m. at Hell Gate, readings taken every 15 minutes showed a difference in the water level of the upper chamber and the lower chamber of an average between 10 and 11 o'clock a. m. of 1.86 inches, the water in the upper chamber subsiding 3.12 inches and in the lower chamber 3.84 inches. During this hour a bottle attached to a fish line was passed the entire distance through the 42-inch pipe three times at velocities as follows: 1.62 feet, 1.74 feet and 1.78 feet. From 11 to 12 o'clock four readings showed an average difference of water level in the two chambers of 1.74 inches, the fall in the upper chamber being 2 inches and the lower 2.88 inches. Bottle tests showed about the same velocity as obtained the previous hour. From 12 to 1 o'clock p. m. four readings showed an average difference in the two chambers of 2:16 inches, the fall in the upper chamber being 6.6 inches and the lower 7.08 inches. No bottle test was made during this hour. From 1 to 2 o'clock four readings showed an average difference of 3.36 inches, the fall in the upper chamber being 1 foot and the lower 1.08 feet. The bottle tests were unsatisfactory but indicated that the velocity did not increase conformably with the change in head.

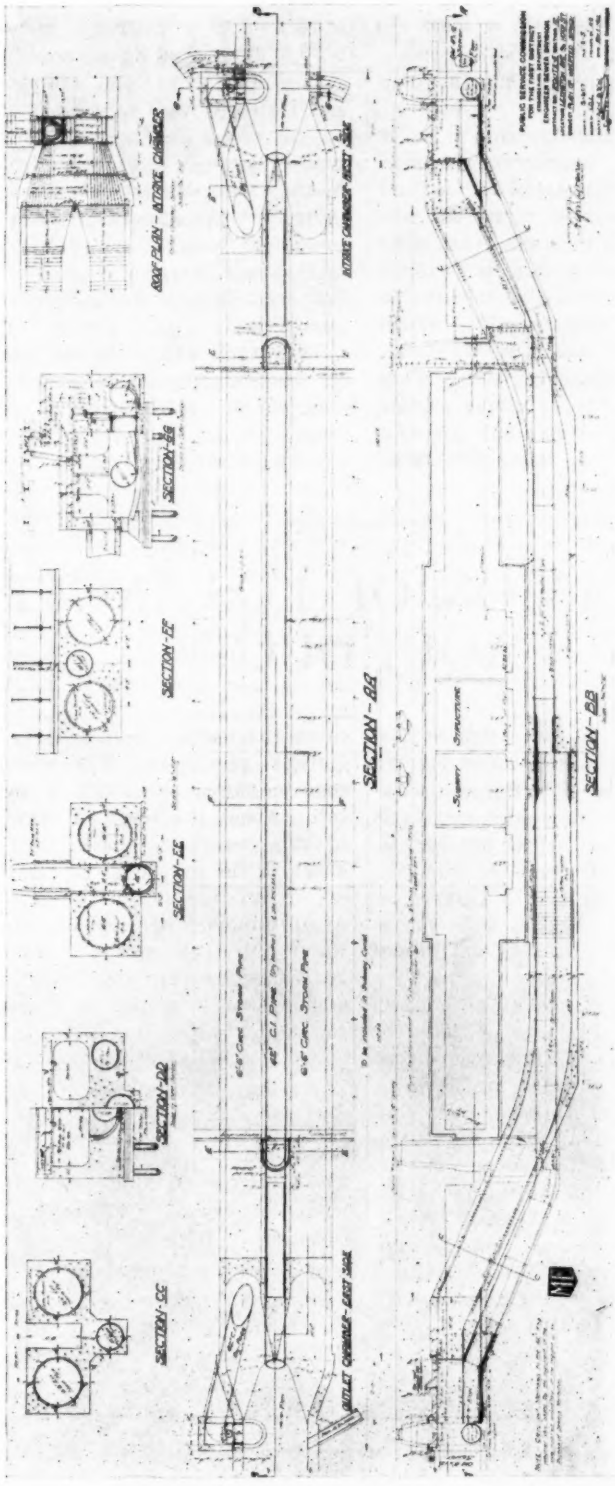
Owing to the large amount of sediment carried in this sewer it soon became apparent that satisfactory results would not be obtained with bottle tests without days of effort, and the use of a current meter was authorized.

On March 5th experiments with an electric meter were undertaken in the afternoon at low tide for two and one-half hours and the results were sufficiently satisfactory to justify further efforts.

The meter was operated as follows: Two 1-inch gas pipes, one 12-feet, the other 10 inches, were joined with a 90-degree coupling and the meter was attached to the short leg. Two hangers were arranged on line with the pipe and at elevations on line with the slope of the pipe at a height to place the meter in the center of the pipe. The 12-foot leg of the gas pipe was then placed in the hangers and lowered into the pipe until the meter was 4 feet from the end of the pipe. The batteries rested on the dam. A working platform was arranged over the invert of the chamber. To clean the meter it was pulled up out of the pipe along the hangers and then raised above the water surface.

If the meter is kept in proper operation one-tenth of the time it is a good average, the remaining time being spent in raising, cleaning and replacing.

There was doubt as to whether this 42-inch pipe was free from sediment, and a drag was made consisting of a channel iron bent to a radius one inch less than the pipe, and covering one-third the inner circumference of the pipe. To this lines were attached to hold, and at the same time pull this drag vertically and transverse to the pipe. A piece of iron plate 1 inch by 6 inches by 13 inches was fastened as an anchor. This drag was pulled through the pipe twice without



PLANS AND SECTIONS *of inverted siphons in sewers to pass under the subways at Lexington Ave. and One Hundred and Tenth St., Borough of Manhattan, New York. Section BB shows a vertical section of the subway, the siphons, the intake and outlet chambers, manholes, etc. Section AA shows a horizontal section of the 42-inch pipe, the two 6.5-foot storm pipes, the by-pass to turn sewage from 42-inch pipe for cleaning it, the intake and outlet chambers, manholes, old sewer, etc. Other sections show the relative positions of siphon pipes, and other structures at different places.*

difficulty. No sediment was removed from the pipe, and no obstructions were encountered. All who witnessed the operation were fully convinced that the pipe was clean.

On March 10th, with high tide at 10:57 a. m. at Hell Gate, current meter tests were again begun at 10 o'clock a. m. and continued until 10 o'clock p. m. The tide this day was unusually low. A drizzling rain set in at about 6:00 p. m. and at 8:30 p. m. had increased sufficiently to make flow in the gutters. The storm gradually increased until 10:15 p. m. when the observations ceased. This storm was unfortunate in giving an abnormal velocity, but shows how slightly an ordinary rain storm raises the water in this sewer, and the capacity of the 42-inch pipe to handle it in addition to normal flow, even at an incoming tide.

The difficulties of obtaining results satisfactorily were well tried out. Many of the meter readings should be eliminated. Among the unusual things caught by the meter was an umbrella frame with in indescribable mass of trash attached, including wearing apparel. A needle and thread were also caught. Human hair and factory waste were constantly annoying.

This work was performed for the Public Service Commission under the direction of Mr. Alfred Craven, chief engineer, and Mr. Robert Ridgway, deputy chief engineer.

DEDICATION OF LOS ANGELES AQUEDUCT

The ceremony of the dedication of the aqueduct of the Los Angeles water supply, which was announced for May 13-15 in the article on this monumental structure which appeared in the April number, is now set definitely for June 17 and 18. The Los Angeles Chamber of Commerce plans a celebration at that time on a scale commensurate with the magnitude and importance of the work.

The intake gates at the upper end of the canal, shown on page 293 of the article above referred to, were opened on February 13, 1913, by eight of the men who have been most interested in the process of construction, including William Mulholland, chief engineer; H. A. Van Norman, J. B. Lippincott, Charles H. Lee, Roderick Mackay, William W. Hurlbut, Frank G. Henderson, and George Shuey. The water from Owens river is now flowing thru the 61 miles of canal, lined and unlined, which carry it to the Haiwee reservoir. This reservoir will contain 63,800 acre feet of water when full. About the tenth of May the gates of this reservoir, shown in the photograph of the gatehouse in the empty reservoir on page 295 of the article in the April number, will be opened and the water will then run thru the 100 miles of covered conduit, 12.5 miles of inverted siphons and 48 miles of tunnels to the Fernando reservoir, whose capacity is 25,000 acre feet. From this reservoir the water will be distributed to the city and other towns and irrigation districts, as described in the article above referred to. The Chamber of Commerce gives itself a month of leeway on the celebration altho there is no apparent reason at this time why the water should not reach the Fernando reservoir on schedule time.

IMHOFF TANKS

THE Imhoff tank is the most modern instrument for removing putrescible substances from sewage, and Professor Ogden has stated the principles of its design very clearly in a paper read before the Dallas convention of the American Society of Municipal Improvements from which the following is abstracted:

The problems to be solved in connection with the use of our streams for carrying sewage are: How may an engineer gage the ability of a stream to receive pollution? How may the amount of organic matter in waste material be reduced or modified, so that the results of the treatment shall permit the wastes to be turned into a stream already overloaded?

The first definite assertion was that a stream would receive without detriment one-fiftieth of its volume of sewage, but would not receive one-twentieth. Recently great stress has been laid on the amount of dissolved oxygen found in the stream, and one treatise says that there is a conflict of opinion in this regard, the range varying with different writers from 20 to 70 per cent. of that necessary to saturate the water.

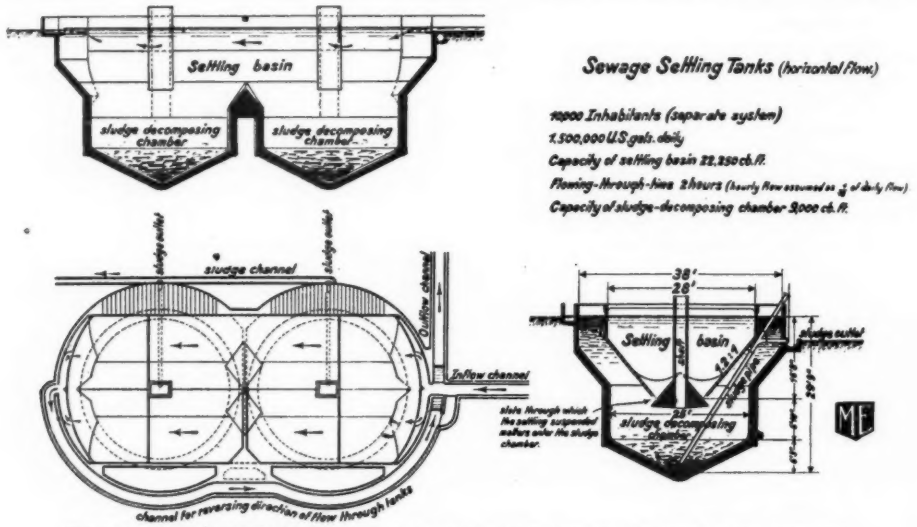
The English sanitarians have attempted to agree upon chemical standards which should draw the line between permissible effluents and those not fit to enter streams. Thus, the Rivers Pollution Commission of 1868 required that no liquid should be discharged into any stream if it contained in suspension more than one part dry organic matter in 100,000 parts of liquid, or more than three parts of dry mineral matter.

The lower Hudson, near Poughkeepsie, is, and always will be, a polluted stream, while the upper Delaware is an overgrown mountain brook. He would be a bold man, indeed, who would ask on purely sentimental grounds that the sewage of Poughkeepsie be purified to the same extent as that of Cooperstown, both cities now discharging crude sewage into the above mentioned rivers.

Out of our uncertainty as to requirements comes a clear note from England as a result of a lawsuit over the pollution of one of their rivers—the Tame. The

IMHOFF TANKS *at Essen, North Germany. There are three pairs of tanks in each group, or eighteen tanks in all, each* 30 *feet in diameter and* 33 *feet deep. Sewage flow,* 17,000,000 *gallons a day. Sewage remains in tanks one hour.*

city of Birmingham alleged that the sewage it was turning into the river was purified quite enough for such a river as had to receive it, while the River Commission claimed that the sewage must be completely purified, no matter what the quality of the river water. The decision of the court was that, "You may not discharge into any stream that which makes it worse." Nobody may make worse a stream by discharging the water into it that has received its excrementitious matter. The principle thus established may not be precisely that which should always govern the degree of purification required



PLAN AND SECTIONS *of a pair of Imhoff tanks for purifying sewage.*

of sewage purification except for the trouble which the precipitated solids gave. About one-half of 1 per cent. of the volume of sewage treated was precipitated as sludge, and the problem of disposing of this was most serious. Today the cities of Worcester and Providence, where some twenty to thirty cubic yards of sloppy, putrescible sludge must be removed inoffensively every day, would, doubtless, consider the sewage problem solved if this foul-smelling mass could be eliminated.

The Imhoff tank has for its claim on the attention of engineers two points; namely, it will, so it is said, remove from in the United States, but it does indicate the tendency to design each sewage disposal plant with particular reference to the degree of purification required by the particular stream into which that particular sewage is to be discharged. No longer, then, will expensive sand filter beds be built to convert sewage into drinking water when the stream receiving such water is already foul.

In the early days of English experimenting, great attention was given to the suspended solids. Apparently it was felt that if the visible particles could be removed, it was all that could be asked. Chemical precipitation, particularly from 1880 to 1890, seemed to be the most promising method of securing this, and chemical salts might have been today the basis the sewage passing thru it at least as much, if not more, of the solid matters contained as any other analogous method, and it will so affect the sedimented solids that they will not smell on standing and will dry out easily, decreasing their volume at least one-half. If the tank will do this last; that is, operate without smell and cut the amount of sludge in two, it is well worth having, and the inventor may well be hailed as one of the great benefactors of the human race.

There are two fundamental principles underlying the design and construction of this tank. First, the volume of sewage in which settling is going on is not subjected to any disturbance by rising gas bubbles; and, second, the sludge is allowed to undergo digestion in a deep

tank for many weeks. The first seems like a small matter, and yet anyone who has watched in a stagnant pool of surface water a string of bubbles rising here and there to the surface will, doubtless, also have noticed particles of black spongy-looking material following the bubbles upward. In a sewage tank where decomposition is going on the phenomenon is the most marked, and it is not uncommon for bubbles to bring up to the surface of such a tank pieces of sludge as large as a man's hand.

It now seems a little thing to argue that better sedimentation would be obtained if the bubbles could be eliminated, and yet a trapped tank bottom for sewage sludge is apparently a real invention of Mr. Imhoff. The trap is very simply made by making the bottom hopper-shaped (which also facilitates the downward motion of the sludge) and by carrying one side past the other so that gases rising from underneath are deflected up along the outside. The beneficial effect of this sort of tank bottom is unmistakable and may be gaged by figures so far as they are available, showing comparisons between this tank and others in the percentage of solids removed from the sewage.

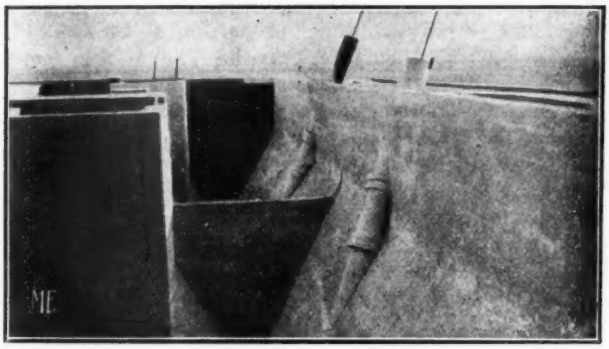
Mr. Fuller says that from 50 to 65 per cent. of the total suspended matter in well-screened sewage can be removed by sedimentation in basins holding from six to twelve hours' average flow. Mr. Fuller also says that in all sewage from 30 to 40 per cent. of the suspended matter is so fine that it is not responsible to the laws of subsidence. At Plainfield, N. J., where the tanks are shallow, 54 per cent. reduction in suspended solids is obtained, and at Reading, Pa., 75 per cent. Somewhat more than these percentages can probably be obtained with a deep circular tank. Thus, at Birmingham, England, where Mr. Watson has used tanks 30 feet deep and 40 feet in diameter, 80 to 90 per cent. of the suspended solids can be removed. Probably the exact amount will depend upon the character of the material in the sewage, the presence of chemicals from factories being a factor in the increase of sludge, while a purely domestic sewage is likely to produce much smaller quantities.

With chemical precipitation a greater proportion of the solids can be precipitated. The actual amount of sludge formed is about 50 per cent. greater than with plain sedimentation, and a large part of this consists of the chemicals introduced to effect the precipitation. Probably a domestic sewage which would lose 50 per cent. of its solids by plain sedimentation would increase this amount to 90 per cent. if chemicals were added in the proper amount.

The Imhoff tank is said to throw down 95 per cent. of the "capable-of-settling" suspended solids, and the advocates of the Imhoff tank explain that the term "capable-of-settling" refers to that proportion of suspended matters in the sewage which will settle out in a measuring glass when allowed to stand quiescent for two hours. If Mr. Fuller's estimate of the amount of colloidal matter in sewage not capable of settling is 30 per cent., then the remainder, 70 per cent., is that which remains as precipitable after the use of chemicals; and if the Imhoff tank will throw down 95 per cent. of this, it means that, of the total suspended solids, it will remove 67.5 per cent. This should be compared with the 50 to 55 per cent. which is obtained from strictly domestic sewage, and it is probably correct to say that the increased efficiency of the Imhoff tank, due to the separation of the rising gas, increases the deposit of solids from 10 to 15 per cent.

The second and more important principle of the Imhoff tank, however, and that on which the growing popularity depends, is its remarkable performance in taking care of the sludge after it has been thrown down from the sewage. Three reasons are assigned for this:

In the first place, below the settling tank proper there is provided a large compartment, in which the sludge is allowed to remain for a long period of time, from three to six months, during which time decomposition proceeds and effectively destroys the organic matter, so that when finally the sludge is removed it is odorless and much reduced in quantity. This, however, is not new. As far back as 1899 experiments were carried on at the testing plant of the Massachusetts



IMHOFF TANK AT SANTA MARIA, CAL. *Interior of completed tanks before sewage was turned in. The pipes in the wall are for removing sludge from the sludge chamber below the V-shaped structure. Haviland, Dozier & Tibbetts, Engineers, San Francisco, Cal.*

State Board of Health, in the hope of carrying out complete disintegration of the suspended solids by prolonged septic action in a separate tank. So, in 1908, Dr. Travis built at Hampton, England, a two-story settling tank, thru which the sewage passed at a high rate in the upper compartment and at a low rate in the lower compartment, where the proportion of solids was much greater. In all these cases prolonged settling in a tank resulted in a gradual and general disintegration of the organic material, and the amount of sludge to be finally cared for was reduced more than one-half from that originally deposited. Even in the bottom of an ordinary septic tank about one-half of the solids were broken up to such an extent that they did not have to be considered in the matter of final disposal.

But in all these cases disintegration proceeded only with a large emanation of sulphuretted hydrogen, and the process, even when the physical benefits were considered, was so offensive as to be entirely impossible. Perhaps no single element has worked more against a greater use of the septic tank than the fact that during the septic process offensive gases are given off. It is to the elimination of these odors that the energies of the inventor of the Imhoff tank were directed, and for this purpose he provides a separate tank for disintegration of solids, but he carries on that disintegration without producing odors. His second point, therefore, was that there must be thru the sludge compartment no moving or renewed fresh sewage. The construction of the tank seems to solve this problem, and the reason has been given as follows:

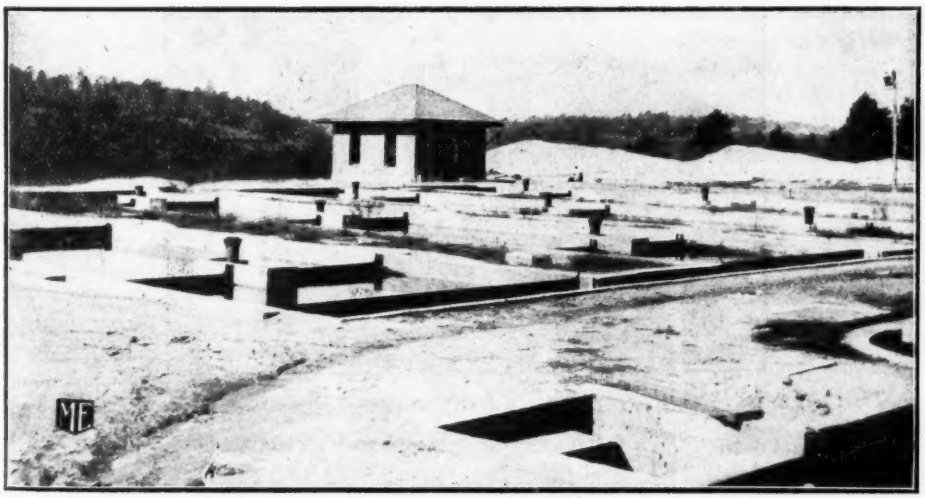
In septic tanks the liquid sewage and the deposited sludge undergo decomposition together, while in the Imhoff tank all supernatant liquid passes thru the tank so rapidly that no septic action is obtained, although in the sludge underneath a very high degree of septicization may be going on. It is said, therefore, that the organic matter in solution, either true or colloidal, is that part of any decomposition that is responsible for offensive gases, and that the deposited solids not subjected to renewed application of fresh sewage do not in their decomposition become offensive. This may explain why the Travis tank smells and the Imhoff tank does not. Other theories have been advanced, and, perhaps, for the present, one is as good as another; but the general testimony of engineers who have seen Imhoff tanks in operation is that there is at the tanks and in their vicinity no objectionable odor.

The third point which seems to be fundamental in the design is that the deposited solids shall be overlaid with twenty-five or thirty feet of liquid. Shallow tanks do not seem to be as effective as deep ones, and the reason assigned for this is that the gases of decomposition which are produced in the lower strata

must, on account of the high pressure, accumulate in greater volume, and in their escape produce a greater separation of the sludge particles than in shallow tanks. It is to this action of the gases in the lower layers of the sludge deposits that Mr. Imhoff ascribes the marked porous condition of the sludge, which gives it its rapid-drying properties after being taken from the tank. The decomposition which goes on at the bottom of the Imhoff tank also gasifies and liquefies a large proportion of the solids originally deposited.

It is not easy from a practical standpoint to separate the effect of the digestion of the organic matter in sludge from the effect of decreased water proportion, since both have the result of descreasing the amount of stored material. Based on experiments of Dr. Spilner and Mr. Blunk, chemist and engineer, respectively, for the Emscher Association, the fresh sludge deposited in the lower compartment contains, on an average, 95 per cent. of water. After remaining several weeks or months in the septic chamber, it will contain only 75 per cent. of water, and about one-third of the original matter will have been either gasified or liquefied. Thru these two agencies an original volume of 100 cubic yards of fresh sludge will be reduced, according to their experiments and figures, to a volume of sixteen cubic yards, a shrinkage in volume of about 84 per cent. They assert that thru septic action only an original five cubic yards of dry sludge matter will be reduced 3.92 cubic yards, a reduction of 22 per cent. The largest part, therefore, of the reduced volume is gained by the loss in water, this being pressed out on account of the great depth of the tank, or indirectly by the greater pressure of entrained gas.

The reduced volume of sludge coming from the tank is not the only advantage. The quality of this sludge is quite different from that of ordinary sludge found in septic or sedimentation tanks. Instead of being compact, non-porous and in texture much like asphalt or rubber, Imhoff sludge is porous and much like a sponge in texture. In the former case drying proceeds with difficulty, and only after prolonged exposure in thin layers to favoring atmospheric conditions. The Imhoff sludge, on the other hand, is so porous that the contained water disappears readily, drying out so that it can be spaded in about five days, and is thereby still further reduced in volume, so that its volume is about 40 per cent. less than when emptied from the tank. In the Essen valley this sludge, except for a slight tarry odor, has always been found by American visitors to be free from objectionable odors, a most marked contrast

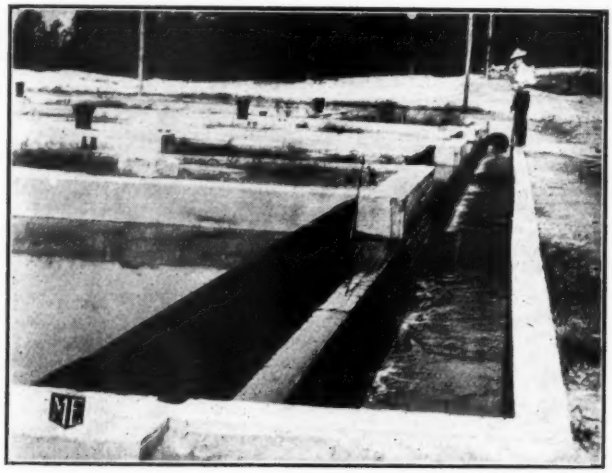


IMHOFF TANKS *at Atlanta, Ga.*

to some of the septic tanks and drying beds which have been built in this country.

Perhaps a final word should be said as to cost. An engineer hesitates to recommend the construction of an underground structure when he knows that it involves a continuous fight against underground water and since sewage disposal plants are generally built on the lowest ground, where foundation soil is the poorest and where the ground saturation is most complete, it is inevitable that the cost of tanks 30 feet down will be high. Wisner estimates the Imhoff tank to cost twice that of shallow tanks designed to provide for the same volume of sewage, although the actual volume of the Imhoff tank is somewhat less. The settling compartment of the Imhoff tank is perhaps only one-fourth that of ordinary tanks in volume, but the storage compartment for sludge underneath is so great that the total volume of the tank is nearly that of an ordinary settling tank. Apparently the practice of Mr. Imhoff is to make the upper compartment large enough to hold about two hours' flow and to make the lower one twice this size. This makes the Imhoff tank large enough to hold about six hours' sewage flow, which is about the capacity of the more recently built septic tanks.

The cost of the Imhoff tanks is higher, even with smaller capacity, because of higher unit prices in both excavation and masonry linings. The question, therefore, resolves itself into this: Is the greater sedimentation, the freedom from odor at the plant and the vastly reduced labor of disposing of the sludge sufficient justification for an increased cost of constructiontion of the tank and for the patent fee which the inventor very properly claims? It has been said that there is no opportunity for equalizing the variable flow in so small a tank and that for best results a large tank (sedimentation) ought to precede the Imhoff tank action. But with every criticism considered, and with full appreciation of the difficulties of the deep tank construction, the boon of an odorless sewage disposal plant is so great and the elimination of the sludge problem so gratefully appreciated, that its rapid installation in this country cannot but follow its European successes.



GALLERY FOR REVERSING FLOW *thru Imhoff tanks at Atlanta, Ga.*

EFFICIENCY IN THE PUMPING STATION

By Seabury G. Pollard, Consulting Engineer, Cincinnati, O., Member of Illinois Water Supply Association.

EFFICIENCY may be defined as the ratio of actual performance to predetermined standard performance. It is the elimination of unnecessary waste.

Let us consider an ordinary every day pumping station such as those in most of our medium sized cities and in many of our larger ones. The buildings are not always practical. The engine room is fairly well equipped, the bright work and brass bands shine attractively, the floor is fairly clean, not much escaping steam is apparent, there are no cracked steam cylinders, the flywheel is all there, a few records are kept and the engineer is apparently well satisfied with himself and the world in general. The boiler room is usually unattractive. It may be gloomy, dirty and repulsive. Possibly there is an unsightly junk pile in one corner, a dilapidated work bench in another or some broken engine parts under the window. The sanitary arrangements consist of a greasy wash pail and a grimy cupboard. Such conditions are reflected in the employes. The fireman in a listless manner now and then fills the furnace up with coal. He occasionally cleans the fires and takes out the ashes. Possibly more or less steam is escaping thru a blownout joint, the heater may be stopped up, the damper will not work, the coal goes on the fire and "the smoke goes up the chimney" just the same and nobody from the manager down considers for a minute that there exist numerous preventable losses all along the line, which in the aggregate may amount to thousands of dollars annually.

Efficient Labor Required

To avoid such losses it is necessary in the first place to employ only efficient and intelligent labor. In many municipal plants the executive is spared this trouble. The employes are selected for him, either arbitrarily because of their effectiveness in their respective wards and precincts, or thru the medium of a civil service board. The first method is bad because the qualifications of the appointees are seldom taken into account. The second is often little better because the examining board is not acquainted with the character of work to be done and is therefore incompetent to judge of the fitness of the men. It does not eliminate political favoritism, and the best qualified men, having no difficulty in getting employment, pay no attention to the examinations. Pre-eminently the person best equipped to select the operating force is the engineering executive.

Operating Standards

The next important problem before the water works operator is the fixing of operating standards. Duty trials of engines and efficiency tests of boilers are or should be made shortly after the installation of this equipment. If for any reason such efficiency trials have not been made or if the results are not available, a competent engineer may be employed to study the conditions existing in the plant, to make such tests as may be necessary or desirable and to establish efficiency standards and proper methods of handling the plant.

To obtain satisfactory results it is necessary that each and every part of the equipment be maintained at all times in the best possible physical condition. In the first place everything should be kept scrupulously clean. The operators themselves are not to be excused from this requirement. Dirt is a visible sign of inattention and where there is carelessness in this particular it generally permeates the whole station. The lawn should be well kept and a flower bed or two may be

added. A picture or two, preferably of up-to-date water works machinery, hung on the engine room wall, a little paint where needed, a neat desk and chair for the engineer and an occasional word of encouragement all assist materially in increasing efficiency. It pays to provide modern sanitary arrangements, including wash room and bath. It pays to provide a light and well ventilated boiler room and to instruct the firemen in the principles of economical firing.

Objectionable Conditions

Having made the plant attractive to the men the next thing is to see that the machinery is kept at its best. The following conditions which are not uncommon in the engine room have no right to exist:

1. Leaky throttle valves, allowing steam to waste thru dead engines.
2. Leaky steam traps, allowing steam to waste continuously.
3. Leaky valves in small piping and bleeder valves carelessly or unnecessarily left open.
4. Steam leaks at pipe joints or from stuffing boxes.
5. Leaks around steam pistons, due to loose or worn rings.
6. Leaky steam or exhaust valves.
7. Leaky shut off valves in steam pipe.
8. Jacket pressures carried too high or improperly regulated.
9. Steam valves improperly set.
10. Poor vacuum due to dirty condensers, air leaks or vacuum pump being out of repair.
11. Excess friction, particularly on pump plungers, because of tight or improper packing.
12. Improper lubrication.
13. Improperly adjusted bearings.
14. Slip and leakage thru pump valves. This is often the most serious loss in the engine room and in some cases tests have shown it to be as high as 30 and 40 per cent. The cause is wornout valves, improper valve springs, lack of valve area and too high speed.
15. Running engines under throttle when they should be operated under cut-off with throttle wide open.
16. Operating duplex pumps short stroke.

Structural Defects

Sometimes there are structural defects which can be remedied at comparatively little cost. Such often cause serious losses. Hot water drainage goes to waste when it should be returned to the boilers. Oil is wasted because there is no means for recovering or filtering it. Steam cylinders, steam and hot water pipes are bare or the covering is of poor quality or insufficient thickness. There is a troublesome air pocket in the suction or an unnecessarily large supply pipe has been taken off the discharge main close to the pumps, for feeding a railroad tank or street flusher. Air chambers are of insufficient capacity or improperly located, water hammer and imperfect filling of the pumps result. Suction pipes have numerous short bends or are laid without regard to grade. Possibly there is a whirlpool at the end of the suction pipe carrying air into the pumps. Perhaps the flywheel "works loose" and frequent stops are made to drive the key. Why should these things be?

It is probably true that in the average plant the boiler room losses outweigh all others, the principal one being due to improper or unintelligent firing. In some cases the construction of the boiler plant is so defective that even with good firing satisfactory results can not be obtained. Very often the whole boiler plant has suffered from lack of care and things have gone to the bad to such an extent that efficient results can not be expected.

When the upkeep of the plant is neglected there may be leaky rivets, joints and tube ends, leaky steam traps, leaks around water columns, at nozzles and safety valves, leaks thru apparently closed valves into boilers not in use. The feed pipe leaks, the blow-offs leak, the feed pump is out of order and the tubes in the heater are stopped up. Do any of these things exist in your boiler plant?

How to Correct Errors

The rational way to correct the errors just mentioned, permanently, is to make the necessary tests and analyses, correct the defects and standardize the condi-

tions of operation. Automatic feed water regulators, recording gages, draft gages, flue gas thermometers, CO2 recorders, Orsat apparatus, gage testers, indicators and the like are very useful and are necessary in making scientific investigations. With one or two exceptions such apparatus unless in competent and experienced hands will do little good.

The principal furnace loss is that due to too much air, furnace temperature being thereby reduced, and 15 to 25 per cent. of the heat of the fuel may in this way be unnecessarily discharged with the stack gases. Insufficient air supply is not uncommon. It is mainly due to defective draft and overcrowding the boilers. With irregular firing there are usually periods of insufficient air supply followed by periods of excess air. Losses both ways.

By all means the best method of increasing boiler efficiency is the installation of automatic mechanical stokers. The cost is about $5 per horse power and even in comparatively small plants the saving in fuel will pay a handsome profit on the investment. Even with stokers the operation should be in accordance with carefully determined methods. Attention should be called to the fact that steam pressures should not vary and that the water level in the boilers should not be carried too high. The first causes loss of both boiler and engine efficiencies while the latter produces wet steam, reduces efficiency and sometimes endangers the engine.

As far as possible supplies should be standardized. It is not ordinarily necessary to purchase the highest priced goods, but exceptionally low prices should usually be viewed with suspicion. Contracts for coal should be made on a heat unit basis.

The care and use of supplies should be as carefully controlled as is their purchase. There should be a definite place for everything and it should be kept there. Incoming stores should be carefully inspected and checked with the order and invoice. Outgoing stores should be measured or weighed. Standard quantities of waste, oil, etc., for a day's use may be determined and the stores issued accordingly. A complete running inventory covering everything in the storeroom is not difficult to keep.

An oiling system in place of the hand regulated cups will save 50 to 75 per cent. of the engine oil, reduce the labor of cleaning 50 per cent. and eliminate hot journals altogether. A little piping, an oil separator and a filter may save 50 per cent. of the cylinder oil. Proper tools conveniently kept, help to keep down the repair account.

Accurate Records Required

It is still necessary that accurate and detailed records be kept. Records are the connecting link between standards and actual practice and indicate at once the cause of reduced efficiency.

All steam, water, vacuum, receiver, jacket and other gages, engine counters, floats, etc., should be read (not guessed at) at frequent intervals, and the readings should be entered in a properly ruled book. They should also be recorded upon looseleaf report sheets for the superintendent. Automatic records from recording instruments should accompany the report. All coal and ash should be weighed and a record kept thereof. The duty of engines should be frequently calculated and any falling off be investigated and corrected.

Cost records should be kept at the main office. They should take into account not only cash expenditures but the actual cost of maintaining the plant for definite periods of time, which is an entirely different matter. The records should carry enough detail to enable the superintendent to determine at once any variation from standards or unusual expense in the upkeep of any part of the machinery.

MOTOR TRUCK EFFICIENCY

A recent report prepared by the National Association of Automobile Manufacturers on the lines of industry which were most interested in the use of motor transportation disclosed the fact that in the engineering and contracting businesses there were 482 inquiries on motor trucks as against about 300 for the next closest industry.

Another very healthy indication of the appreciation of motor transportation by contractors is evidenced by the frequent requests which motor truck manufacturers receive for the rental of trucks for some particular contracting work.

One of the most interesting examples of the value of the motor truck in the contracting business is shown in the traffic investigation recently made by the Transportation Cost Department of the International Motor Company. The company in question, The Crescent Delivery Company, New York City, is engaged in the sale and distribution of sand, gravel and broken stone. Their transportation equipment consists, in addition to horse-drawn trucks, of three Mack dump trucks of 7½ ton capacity.

Conditions

All the hauling is done from the company's dock, at the foot of East 35th Street (with very few exceptions). The materials are delivered for the most part in the downtown section, so that the hauls are short, the average distance being 2.95 miles. Time required for loading and unloading is reduced to a minimum. The various materials handled are carried in large overhead hoppers, which are kept filled by one steam and one electrically operated boom derrick, with clam shell buckets. The trucks run underneath either one of three hoppers, there being one each for sand, gravel, and broken stone, from which they are loaded, in a few seconds, by opening a swinging gate, or valve, in the bottom of the hoppers. These gates are operated by attendants, so that the truck drivers remain on their seats, and move their trucks as soon as filled to make room for other vehicles, of which there are usually a number waiting in line. The motor trucks, as a rule, are given precedence over the horse wagons, not being required to wait in line.

The unloading is accomplished with equal facility, on account of the power dumping bodies, although there are occasional slight delays when the drivers must see the contractor's foreman to ascertain where load is to be dumped, etc. These cases seem to be the exception.

The trucks, being confined to city work, are operated over unformly good roads, excepting at the dock, where the accumulation of broken stone, and the fact that more or less maneuvering is required, doubtless affect the tires to some extent, by abrasive action.

The only causes of delay are these noted above, which are almost negligible, and those due to congestion in traffic in the downtown section.

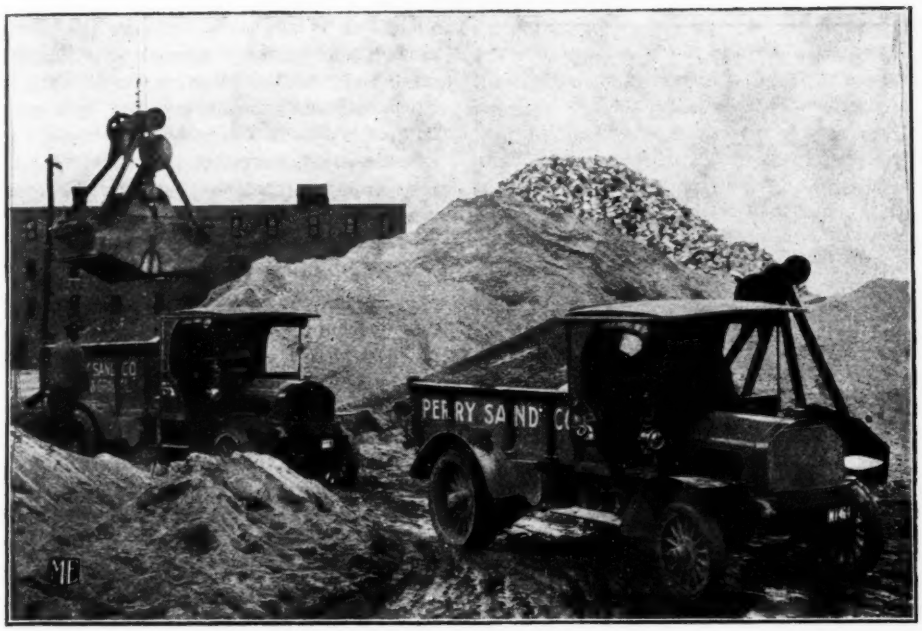
Equipment

The three trucks are of standard construction, having bodies of nominal five yards capacity. By loading with a "crown" it is possible to load them with six yards. They were delivered with dual 42 inch by 6 inch tires, of block type, which have recently been changed to 42 inch by 5 inch triple tires, these being endless.

The trucks are geared for a maximum speed of 10.2 m. p. h. the original 13-tooth sprockets having been changed to the present 11-tooth size.

Operation

The trucks are operated nine hours daily, in which time 6.7 trips are averaged daily. The trucks make an average speed of 9 m. p. h. not including traffic or other stops, while the actual speed,



LOADING SAND *for Perry Sand Company into Mack patent automatic dump trucks. One machine does the work of fourteen wagons and cuts delivery cost in half.*

as governed by traffic conditions, is 7.3 m. p. h. The maximum speed, with engine limited to 1,000 r. p. m. is 10.2 m. p. h.

The average time required to load, from the time the truck arrives at the dock, till it leaves the office where drivers receive delivery slips, is 5 minutes. The average time for unloading is estimated to be 8 minutes.

The loads vary from 15,000 lbs. in the case of broken stone, to 16,200 lbs. for a full load of sand.

The condition of the three machines, at this time, is excellent and it is evident that they are well looked after, even to the extent of frequent washing and polishing of brass.

The drivers are better than the average and take good care of their machines.

Maintenance

The garage facilities are of the best, and the location of the garage, in East 31st Street, reduces dead mileage to a minimum.

No facilities are at hand for repair work, except light repairs, as there are no machine tools, benches, etc.

Ample provision for daily attention, such as oiling, greasing and minor repairs and adjustments, is made by the employment of one mechanic, all of whose time is given to that work.

Practically no spare parts nor equipment are kept on hand, and in view of the close proximity to the service station, this seems unnecessary.

The figures for mileage, trips, etc., are based on the actual performance of the trucks for two weeks—from November 11th to 23d, inclusive, and were obtained from authoritative sources. The figures for average speed are based on the observations under various conditions. All the above are summarized below.

REPORT ON COST OF OPERATION OF THREE 7-TON MACK DUMP TRUCKS. CRESCENT DELIVERY CO.

Conditions:
Average daily mileage.....39.5 miles
Average trips ..... 6.7 miles
Average length of haul..... 2.95 miles
Average load, 8 tons.

Assumption:
300 working days per year.
11,850 miles per year (each truck).
100,000 miles, life of truck.

Investment:
3 7-ton Mack dump trucks.....$17,400.00

Fixed Charges:
Interest on $8,700 at 6 per cent..$ 522.00
Insurance: Fire, 2 per cent. on 80 per cent. of value..... 278.40

DUMPING BROKEN STONE, *Crescent Delivery Co., at Corona, L. I.*

Fixed depreciation (exclusive of tires) on $15,450, 10 per cent..	1,545.00
Wages, at $22.50 per week.....	3,510.00
Garabe, at $20 per month.....	720.00
Total fixed charges.....	$6,575.40
Operating Charges:	
Depreciation, 1 per cent. per 1,000 miles for all mileage in excess of 1,000 miles.....	$ 285.83
Maintenance, at .079 per mile (approximately)	2,821.00
Tires, at .0809 per mile.....	2,877.42
Gasoline, at .067 per mile.....	2,380.07
Oil and Grease, at .013 per mile...	468.00
Total operating charges.....	$ 8,832.32
Total cost per annum.....	15,407.72
Average cost per day.....	$17.12
Average cost per ton mile.....	.108

On two consecutive days, in the above period, the trucks averaged 60 miles per day, and, while this is considerably in excess of the general average, it was accomplished without unduly speeding, the machines not working overtime, so that it is apparent that the fact that the average daily mileage is only 39.4 miles is not due to any limitation of the machines, nor loading and unloading facilities.

It seems to be the policy of the company to hold this equipment more or less in reserve to the horse wagons, and while the wisdom of this policy cannot be questioned in view of the fact that the horse equipment costs practically the same whether working or idle, it must be borne in mind that the condition is unfavorable to the most efficient performance of the trucks. On the days when the machines are kept busy the efficiency, or the ratio between ten-mile performance and cost of operation, including fixed charges, must certainly be considered better than that of the horse equipment.

Conclusions.

The conditions as outlined above, disclose very little which is abnormal, or which would justify any dissatisfaction on the part of the owners. The short

DELIVERING BROKEN STONE *for Hugh Nawn Contracting Co., with Mack five-ton coal truck of International Motor Company.*

hauls, traffic delays, etc., are inherent to the business but these are largely overcome by the exceptional facility with which the trucks are loaded and unloaded. The drivers are under efficient supervision, and there seems nothing in connection with the handling of the trucks, while in service, that is subject to any improvement.

The average consumption of gasoline for the period covered by this report, and since it was known that an investigation was in progress has been considerably less than what it was before, according to Mr. Warren, secretary to the company, and while no deduction should be drawn from this fact, it suggests a better check on this item of expense.

MOTOR TIRE WEAR IN VARIOUS CITIES

The accompanying tables are but three from the data contained in a report of an investigation made by H. W. Perry, secretary of the commercial vehicle committee of the National Association of Automobile Manufacturers, into the reasons for the variations in wear and tear of automobile tires. This investigation is limited to truck tires and it is evidently impossible to eliminate entirely from it the effect of runs into the country. They are undoubtedly, however, but a small percentage of the tire mileage reported upon.

The first table gives the mileage of each class of pavement in each city covered by the investigation, and the mileage of unimproved streets (earth and gravel).

The second table gives the average mileage of all tires on both electric and gasoline trucks, the total mileage of paved and unpaved streets, and the percentage which the smooth paved streets is of the total mileage of paved streets; also a brief characterization of the topography of the city.

The third table gives the actual average tire costs in the different cities for a one-ton truck.

For any other size of truck the average annuali tire cost per truck can be computed from the following average normal annual tire cost per truck for the various capacities of trucks:

Truck Capacity—Tons	Av. Normal Annual Tire Cost per Truck
1	$ 350
2	500
3	700
4	950
5	1,100
6	1,300
7	1,450
10	1,650

Table No. 3 and this addendum to it were apparently computed from a combination of costs of trucks of all the various sizes, the list of those in use probably not covering all the sizes in every city.

This computation is of much interest, but it must be taken simply as an indication and not as an actual determination. In the first place the number of trucks is rapidly increasing and so the effect of new tires on the average is greater than it will be after the business becomes more settled. In the second place, purchasers of trucks must learn what is the best tire for their service. Thus the Rapid Transit Motor Company of Indianapolis found tire expense to be very heavy at first, but an increase in size of wheel and a change in design of tire has very greatly diminished the tire expense. Again, many trucks in some cities must run on unimproved streets or area ways, while in other cities the pavements are equal to those on the streets in general, a difference in conditions which is faintly indicated if at all in the tables.

At the present time an investigation of trucks running outside of cities would show even higher tire expense than is here shown, except for the fact that only in three or four states are the main roads so well improved as to attract the truck traffic which is ready and waiting for a

road good enough to make it possible to drive trucks over it at proper speed and with large enough loads to make such traffic profitable.

TABLE No. 1, MILEAGES OF DIFFERENT KIND OF STREET PAVING IN TWELVE LARGE CITIES.

Paving Material	Greater New York	Boston	Philadelphia	Baltimore	Washington	Buffalo
Asphalt	755.01	22.15	490.30	36.	146.33	240.8
Asphalt Block	165.24	.....	15.	.....	32.32	.....
Tar Composition & Bitulithic	31.3	19.89	12.77	10.	2.	.....
Wood Block	34.10	3.59	2.22	2.	.....	.....
Stone and Slag Block	16.95	.....	5.82	.....	.....	21.0
Brick	19.24	5.19	171.35	.....	1.40	27.9
Granite Block	306.95	98.68	394.59	43.	26.10	.....
Macadam and Telford	742.38	363.	306.49	59.	90.50	15.4
Cobble and Rubble	44.83	.29	22.81	238.	3.96	.....
Earth and Gravel	782.10	46.37	460.	38.	163.56	292.8
Other	.62	2.19	.....	.....	.....	71.4
Total Street Mileage	2898.72	561.36	1871.35	426.	466.17	669.3
Total Paved	2116.62	515.	1421.35	388.	303.61	376.5

Paving Material	Pittsburgh	Chicago	St. Louis	Kansas City	San Francisco
Asphalt	187.	583.90	67.27	218.84	30.
Asphalt Block	.....	.....	.....	.....	.....
Tar Composition & Bitulithic	2.	.87	45.43	1.15	157.
Wood Block	.48	328.79	9.38	1.33	.....
Stone and Slag Block	232.5	.....	.....	.....	95.
Brick	65.5	181.20	171.49	38.62	.....
Granite Block	.....	103.34	72.32	6.50	.....
Macadam and Telford	8.6	580.80	272.53	71.19	120.
Cobble and Rubble	195.	.....	.....	.....	10.
Earth and Gravel	.....	2676.40	294.73	.70	.....
Other	.....	22.18	.....	4.16	.....
Total Street Mileage	.....	4477.48	933.15	342.49	.....
Total Paved	515.58	1801.08	638.42	341.79	412.

TABLE No. 2, TIRE MILEAGE AND STREET PAVING IN VARIOUS CITIES.

City	Average Mileages of all tire on both Elec. & Gas Trucks	Percentages of Asphalt, Asphalt Block, Bituminous and Wood Block paving to total miles paved streets	Total Miles Paved Streets	Unpaved Streets	Topography
Baltimore	3,617.6	12.3	388.	38.	Hilly
Pittsburgh	4,542.6	36.7	515.58	.....	Very Hilly
Boston	5,814.2	8.8	515.	46.37	Level
San Francisco	5,869.8	45.0	412.	.....	Hilly
Greater New York	6,576.7	43.0	2287.52	782.10	Level
Philadelphia	7,134.1	36.5	1421.36	460.00	Level
Buffalo	7,263.2	64.0	376.5	292.8	Level
Chicago	7,945.9	56.0	1801.08	2676.4	Level
St. Louis	10,245.5	19.0	638.42	294.73	Partly Hilly
Kansas City	10,571.4	64.0	314.8	.....	Very Hilly
Washington	11,065.4	59.0	303.61	163.56	Level

TABLE No. 3, COMPARISON OF ACTUAL AVERAGE TIRE COSTS IN DIFFERENT CITIES WITH NORMAL AVERAGE COST, TRUCKS OF ONE-TON CAPACITY:

Average normal annual tire cost per truck	$350	100%	Philadelphia	392	112
Baltimore	733	221	Buffalo	388	111
Pittsburg	616	176	Chicago	350	100
Boston	479	137	St. Louis	273	78
San Francisco	476	136	Kansas City	262	75
New York	425	121.6	Washington	252	72

CONDITIONS OF MOTOR TRUCK ECONOMY

The development of the use of the motor truck began not long after the rapid development of the automobile had been established but its effect in displacing horse-drawn vehicles did not come into evidence strongly until within the last three years. It is not possible to give close definite figures covering all items of cost as yet, but those of operation are now available in considerable numbers. Some of them are given in various articles in this and other numbers of MUNICIPAL ENGINEERING and generally show economy in the use of motor trucks.

Certain principles have been discovered to govern the matter of economy and probably others will appear later. Mr. J. O. Handy states some of them in his presidential address before the Engineers' Society of Western Pennsylvania as follows:

"Trucks must be kept in practically constant use.

"They must be loaded to full capacity when in service.

"Loading and unloading must require but a small proportion of the time in service.

"The truck must not be overloaded.

"Normal speed of operation is best.

"Adjustment and repairs should be done by competent workmen.

"The driver must be well qualified for his work."

The figures of cost which are given should be examined carefully to see if all these principles have been followed. One most important element of cost is that of depreciation. Trucks generally are not yet old enough to show what is a reasonable allowance to make for this item. Evidently it must be greater for some services than for others, and will depend largely also on the closeness of adherence to the principles stated.

Mr. Handy states that the number of motor trucks in use in this country is about 50,000. The rapidity of increase in their use is shown by the 62 per cent. increase in one year in number in use in Massachusetts, 100 per cent. in Washington, 120 per cent. in Chicago, and the like.

One line which seems to meet the requirements of the principles stated is that of the motor bus on a regular route running on schedule time. The success of the motor bus on Fifth Avenue, New York, is hardly representative, because of the specially favorable conditions on that street. The history of the Rapid Transit Motor Company, of Indianapolis, is of more general application.

This company began operations in November, 1911, with seven automobiles on a single route. The service is described in MUNICIPAL ENGINEERING, vol. xli, p. 478. After a careful trial of this route, part of which gave better service to a section of the city which did not have good street car service, the line was shortened and then was changed in route until a district, still in the same section of the city, was found which promised sufficient traffic to pay. Part of the reason for lack of sufficient financial return was probably the rates of fare, which were 10 cents for a single ride, ten tickets for 50 cents, and twenty-one tickets for $1, while the street cars on adjacent streets for most of the route charged 5 cents single, six for 25 cents, and twenty-five for $1. The service to the district last tested was put on the same fares as the street cars and is now financially successful. On this route, which is somewhat shorter than the first one tested, three buses are run. Three have been put on a part of that first route, and with the lower rates of fare these also are successful. One bus is kept in reserve and repairs take so little time that it is available for special service to parties and the like. In the summer the service is changed somewhat and two buses are used on a cross town line to one of the principal parks, meeting a great demand and having adequate financial returns.

Plans for increasing the service and extending it to other parts of the city are under way.

Besides the economy which can be shown in comparison of such service with horse-drawn vehicles is that in comparison with the street car system, when traffic is not too heavy and lines are not too long. The bus line has the further advantage that is it movable and can be put on any line which gives the best returns and thus meets the demands of the public most nearly. The advantage of having single units of power is seen when snow delays the whole system of street cars, while the bus can pick its way and get thru somehow. It is also shown when the power house is out of commission, as in the late floods, when the only regular method of transportation available for several days was the bus line. There is a large field for this sort of development which is now open. The experiments which have been made on small scale in a few cities have given a basis for others which can take advantage of the experience already gained.

Another condition under which economy of the motor truck can be shown is in short freight hauls. Much of the experience of short railroad haul is in the loading and unloading of cars. This can all be eliminated by using the truck. The ordinary route of a shipment under present conditions is from the store or factory to the truck, from the truck to the freight depot, into the car, out of the car into the receiving depot, and from the freight depot to the purchaser. It is more direct, requires less handling, which adds greatly to the expense, cuts out one company and its profit, and adds nothing to delivery charges at either end, to send the truck to the city or town in which delivery is to be made. The only requirements for economy in the operation are those stated at the beginning of this article. There is much leeway in the terminal expenses to overcome the difference between actual cost of running the automobile and the freight car between the two cities after they are well out of the city and on the way. The economy will be still greater when the roads of the country are improved to meet the increasing demands of this class of traffic, thus reducing the cost of traction and the liability of breakage and accidents.

MOTOR TRUCK AND TRAILER *running in competition with steam railroad from Braunschweig, Germany. Note superior character of surface of road.*

Germany is developing this class of traffic more rapidly than the United States, because the better roads in that country invite it, whereas many of our main roads are wholly unable to carry it. One of the accompanying photographs shows a German motor truck and trailer which is a successful competitor of the steam railway on regular routes running out of Braunschweig.

SUSPENSION OF TROLLEY WIRES FROM BUILDINGS

By L. A. Dumond, Engineer, Committee on Down Town Streets, Chicago Association of Commerce.

The movement to remove trolley poles from the streets in Minneapolis, and later in St. Paul, originated with the company. It was prompted by the desire to remove obstructions from the streets in the downtown district, and to secure a method of construction believed to be safe and more economical. Absolute uniformity could not be secured in all cases because of vacant lots or buildings of insufficient height. Otherwise poles are removed wherever possible. No attempt would be made to attach the eye-bolts used to any frame building, or any building with a thin veneer front. Out of 7,708 poles used in Minneapolis, 500 have been replaced by eye-bolts attached to the buildings. The spacing of trolley poles varies from 100 to 110 feet. Figuring an average spacing of 100 feet, then 50,000 feet, or 9.47 miles of poles are replaced in Minneapolis. The eye-bolts used are made of steel and heavily galvanized to prevent rusting and staining of the buildings. No complaints from this source have ever been received. The eye-bolts cost 16 cents a piece, and the total cost of mounting eye-bolts and attaching the supporting wires is $2.00. The cost of a trolley pole set in concrete in Minneapolis varies from $20.00 to $22.00. Upon original construction the saving made by using eye-bolts attached to buildings in place of trolley poles would have been:

500 poles set up complete, at $20.00	$10,000.00
500 eyebolts mounted complete, at $2.00	1,000.00
Saving	$ 9,000.00

However, Mr. Scofield states that while on new construction they do not now set trolley poles in concrete, most of the trolley poles removed were so set, and the cost of removal plus the cost of mounting the eye-bolts often amounted to as much as the cost of a new pole set up complete.

The city of Minneapolis cannot compel the property owner to permit the attachment of trolley wires to his building. The permission to attach trolley wires is purely voluntary on the part of the property owners and arises from the desire to do away with an unsightly obstruction. In obtaining consents to attach trolley wires to the buildings, the street railway company first sends a solicitor to the property owner who explains the advantage of removing poles and presents an agreement for the property owner to sign as follows:

> Permission is hereby granted the Minneapolis Street Railway Company to install ..... eye-bolt.... in the ..... wall of the building located at..... (Signed)..... .....1913.

In case the property owner does not grant the desired permission, the name is turned over to the Civic and Commerce Association who again take the matter up with the property owner. The Civic and Commerce Association has been very successful in securing consents for mounting eye-bolts upon the buildings, and thus helping to clean up the streets.

The company has never received any complaints as to the interference of these wires in case of fire, nor has the service ever been interrupted from this cause.

There is nothing to the charge that short circuits might be caused in steel buildings. The trolley wires are doubly insulated from the buildings. The trolley hanger used is itself insulated, and another standard wooden insulator is placed in supporting wire at the curb line.

There is nothing to the objection that the eye-bolts might be pulled out because of the great weight upon the supporting wires. But one case of this kind has ever

occurred in Minneapolis. In this case a workman by mistake fastened an eye-bolt into the veneer of a brick building. The company does not attempt to fasten these eye-bolts to a building with a veneer wall only, or to the veneer surface of any building. In all other cases where the eye-bolts have been fastened to the wall of the building itself, to the full length of the bolt (8 to 10 inches) no bolt has ever been pulled out or even loosened. The strain upon these bolts communicated by the supporting wires varies from 500 to 700 pounds, about the same as that existing on the supporting wires in Chicago, according to the statements of Mr. Murphy, chief engineer of the Chicago Railways Co.

For supporting wires a three strand No. 11 galvanized wire is used.

Mr. Scofield states that in case it was feared that the strain upon one eye-bolt might be too great, two eye-bolts might be used, placing one above the other. He has not up to date found this precaution necessary, but states that he would employ it if the conditions warranted.

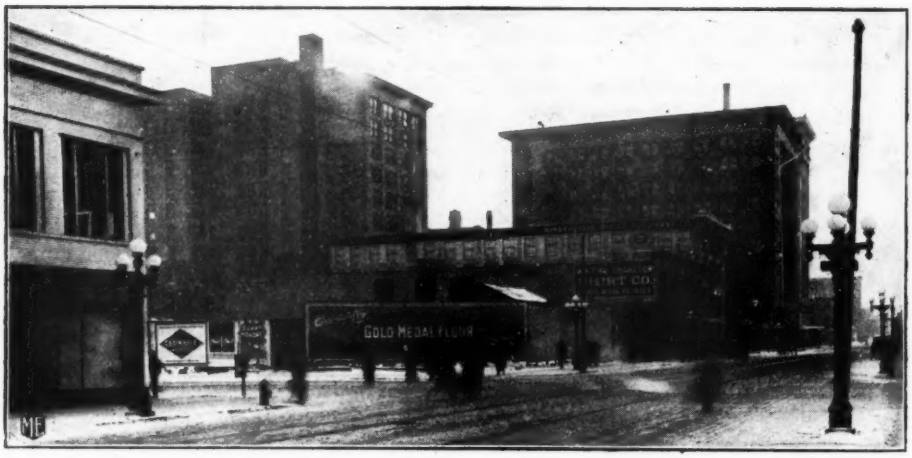
The width of streets upon which this method of suspending wires is employed varies from 80 to 100 feet. No troubles of any nature have ever occurred in a street of 100 feet width with this method.

The eye-bolts are fastened to the building at a height varying from 26 to 27 feet.

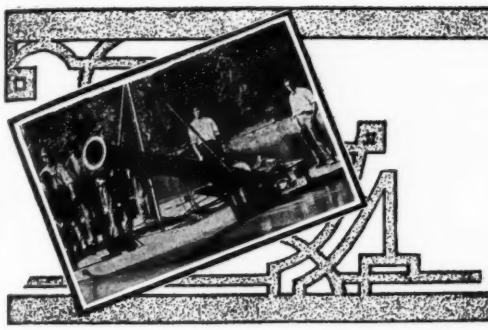
Two objectors to the plan gave reasons as follows:

New York Life Building in Minneapolis; Nichols & Tuttle, Managers: Mr. Nichols says that they at first refused permission to mount eye-bolts because of their fear that the strain upon the wires would pull the eye-bolts from their mounting in the terracotta. Permission was finally granted upon the plea of the Civic and Commerce Association to permit of the installation of an ornamental lighting system with which the poles interfered. No trouble has been experienced as feared and the managers are very well satisfied, and admit the poles were a great obstruction. Mr. Nichols believes that many of the objections originally raised to the scheme were due to not comprehending what the method really involved, and also a false idea as to the amount of pull upon the supporting wires.

Post Office Building in Minneapolis: The custodian of the building could not give permission without authority from the supervising architect in Washington. When the method of suspending wires was explained fully to the supervising architect, permission was granted.



TROLLEY WIRE SUSPENSION *from building on the left and from pole on the right.*



EDITORIAL

BUILD THE ROADS FOR THE TRAFFIC TO COME.

The most important question in road design and construction at present is that of the character of the traffic which will be developed over the new road when it is built. Many miles of improved macadam and gravel roads were built by the first state highway commissioners at heavy expense which were fully adequate for the traffic of the day. But the automobile developed into a practicable fast-moving vehicle which proceeded to tear these roads into pieces. Many miles of these roads have received additional treatment or have been more or less completely rebuilt at large additional expense to carry this new traffic.

And now, over these new roads comes a new development of automobile travel, the truck, with or without its trailers, and demonstrates the necessity for still better roads than it has been customary to construct.

Each change in traffic conditions has been contested by means of laws regulating the use of the roads, and each new class of traffic has been assessed what was thought to be its share of the increased expense of maintaining the roads in good condition.

The theory seems to have been that the traffic must be regulated to suit the road over which it must go. But that theory is wrong, as the most progressive commissioners and engineers have long recognized, and the true theory on which we should proceed is that the road must be built to carry the traffic which comes to it. So those states which are just beginning their modern road improvement must consider, in making the design of a road, not what its traffic is at present, but whether the improved road will have a small amount of ordinary farm traffic, a larger amount of such traffic on its way to market and gathered up from the neighborhood roads, a thru traffic of fast-moving automobiles, horse-drawn or motor-drawn heavy traffic, or combinations of one or more of these.

The main roads are those which are most difficult to care for, and it is each year becoming more evident that they must be built with foundations heavy enough to carry any loads which the new traffic can bring to them, and must at the same time have surfaces good enough to withstand lighter rapidly-moving vehicles.

How extensive this new heavy traffic will be is only suggested by the data on truck traffic which are given in this number of MUNICIPAL ENGINEERING and will be followed by more each month on all classes of heavy and light traffic. The necessity of the heavier roads is already demonstrated by figures and will soon be demanded by such traffic, the economical development of which will be handicapped by insufficiency of roads until the road officials of states and counties have the demonstration forced home to them and respond by improving the roads to the limit required.

ONE FLOOD LESSON.

One lesson has never been taught by experience with floods, which was brought into greater prominence than ever by the March floods which were so phenomenal in Indiana and Ohio and were widespread thruout the Mississippi Valley in particular. This is that of the error in locating public utilities where they are in danger of being put out of service by floods and in retaining them in such locations after this danger is definitely demonstrated.

The main pumping station of the Indianapolis water works was flooded by the breaking of a city levee at some distance from the plant. These works have been in similar trouble at least twice before, and it would certainly be the part of prudence to protect them by their own walls and levees and pumps for removing leakage, if it is not considered advisable to elevate the plant above all danger of overflow. The power stations of the street railway plant, which is owned by one of the interurban systems, were flooded and out of business until the apparatus could all be dried out. There is apparently no reason, except the comparatively small expense, for failure to elevate the essentials for continuous operation without reference to floods, and to protect by levees all parts not subject to backwater from the river thru outlet sewers or conduits. The works of one gas company were practically without protection from flood and stopped manufacture of gas early in the flood. One of the street railway power houses and the gas works were located after the flood of 1904 and must have been constructed with full knowledge of what might happen at any time.

Memphis, Tenn., is safe from overflow except a few acres along a bayou, which area is usually protected by a levee and a pumping plant for sewage and seepage. The gas plant is outside this levee, however, and was protected during the early days in April by a levee of sand bags several feet high, and was in constant danger. There is apparently no very good reason why this plant should not have been located on high ground. The bonding of the city for the construction of a levee along the bank of Wolf creek which will protect this and several private manufacturing plants in the vicinity is under serious consideration. The city water works plant is in similar condition altho it is behind the existing levee. The peculiar circumstances of its development give better reasons than usual for the location.

Terre Haute, Ind., gas and electric light plants were put out of business, but the water works developed only one weak spot, which did not completely close the plant.

Water filtration plants at Albany, Green Island and Rensselaer, N. Y., were put out of commission. That at Columbus, Ohio, seems to have been almost wholly protected.

Ground water supplies at Memphis, Tenn., and Oswego, N. Y., were polluted to some extent by inflow of flood water. That at Dayton, Ohio, was so well protected that no surface water entered, and as soon as the pumping plant could be started and the broken pipes and hydrants shut out of the system the usual supply was furnished in the usual condition.

Water, light and power plants in many smaller cities were put out of commission.

When plants in cities so seriously flooded as Columbus and Dayton come thru with no damage to their water supplies, altho the floods very seriously damaged their distribution systems, there seems to be no very reasonable excuse for the other cities, especially for those that have built plants in recent years with their frequent floods approaching or exceeding former maximum levels.

MEN PROMINENT IN MUNICIPAL AFFAIRS

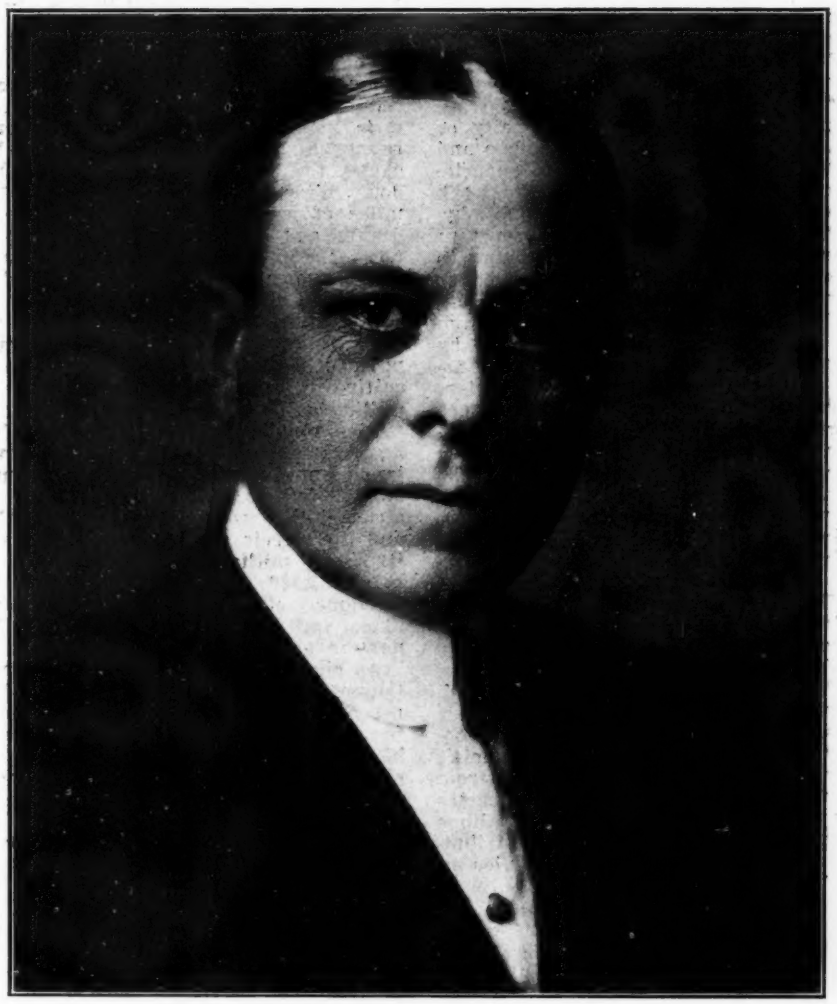


Photo by Moffett, Chicago.

JOHN ERICSON, *City Engineer, Chicago.*

John Ericson, city engineer and chairman of the Harbor and Subway Commission, of Chicago, Illinois, graduate of the Royal Polytechnic Institute, Stockholm, Sweden, in 1880.

After three years' service in minor capacities with the United States government, private and public corporations, Mr. Ericson entered municipal service as a draftsman in the engineering department of Chicago in 1884; he was steadily advanced through the positions of assistant engineer, and first assistant city engineer, until 1897, when he secured the appointment of city engineer.

As city engineer, Mr. Ericson has

charge of the Bureau of Engineering, which is made up of the following divisions: Pumping station and crib division, directed by a mechanical engineer in charge, who supervises the operation, maintenance and repair of all pumping stations and cribs; the water pipe extension division, in charge of a superintendent, to whom is assigned the work necessary in the repair, extension and management of the water carrying facilities and waste water surveys carried on by means of pitometers; the construction division, reporting to the engineer of water works construction, to whom is assigned all construction work performed by city or private forces; the water works shop and repair division in charge of a superintendent, to whom is assigned the work of making repairs to boilers, pumps, hydrants, valves and other city property; water meter shops division, reporting to the general meter foreman, who makes the necessary repairs, replacements and installations of water meters; the division of bridges and viaducts, directed by an engineer in charge, to whom is assigned all work necessary in the design, construction, operation and maintenance of bridges, viaducts, docks, etc.; the division of rivers and harbors, which has supervision over the Chicago river, the Calumet river and Lake Michigan for a distance of three miles from shore, enforcing such municipal laws as relate to marine interests, such enactments of the state legislature and the regulations of the United States government in regard to rivers and harbors; and the testing division, in charge of an engineer of tests, to whom is referred such materials as require testing for compliance with specification.

Since acting as first assistant city engineer and city engineer, the pumping stations of the city have increased from two to fifteen in number, the capacity from 350 million to 900 million gallons per twenty-four hours, and the distributing mains from 1,400 to 2,500 miles in length.

After having become city engineer, Mr. Ericson devoted considerable time to the study of bridges and under his supervision there has been developed a special type of bascule bridge, the first of which was constructed in 1901. There are now ten of these bridges in operation, five under construction, and plans for several more are being prepared, notwithstanding the fact that the installation of these bridges has been retarded more or less owing to the opposition of people who own or control patents on other designs.

No difficulties present themselves to the city engineer more than those connected with the development and maintenance of an adequate water works system, and these are especially pronounced in Chicago, owing to the peculiar nature of the city, which has an exceptionally large area, with well built up suburban districts on the outskirts, requiring extra heavy pumping and distributing facilities. Other difficulties demanding attention along this line are old and defective plumbing, which increases leakage and waste, and an over-abundance of underground feeder wires, which has done considerable damage by electrolysis.

To give the reader an idea of the amount of work performed under the direction of the city engineer of Chicago, it is thought advisable to quote from a recent annual report of the bureau, which shows the following work having been done during the preceding year: 71.17 miles of water pipe laid; 1,690 fire hydrants and 673 valves placed and connected; 185,176,323,000 gallons of water pumped against an average head of 114.99 feet at a pumpage cost of $0.0356 per million gallons 1 foot high; pitometer surveys covering twelve square miles of densely populated city area, resulting in the elimination of the loss of 19 million gallons of water daily due to defective plumbing and underground leakage; the completion of the southwest land tunnel system, comprising tunnels from 9 feet to 14 feet in diameter, constructed thru rock under Lake Michigan and the streets of Chicago, with a capacity of 400 million gallons daily, at a cost of $3,062,520; the completion of bridges previously started and the preparation of plans and specifications for the bridges now under construction.

As chairman of the Harbor & Subway Commission, Mr. Ericson has directed the preparation of reports on routes and estimates of costs for a subway system to be utilized in connection with the present elevated and surface car system. The estimated cost of this system exclusive of equipment, is about $20,000,000.

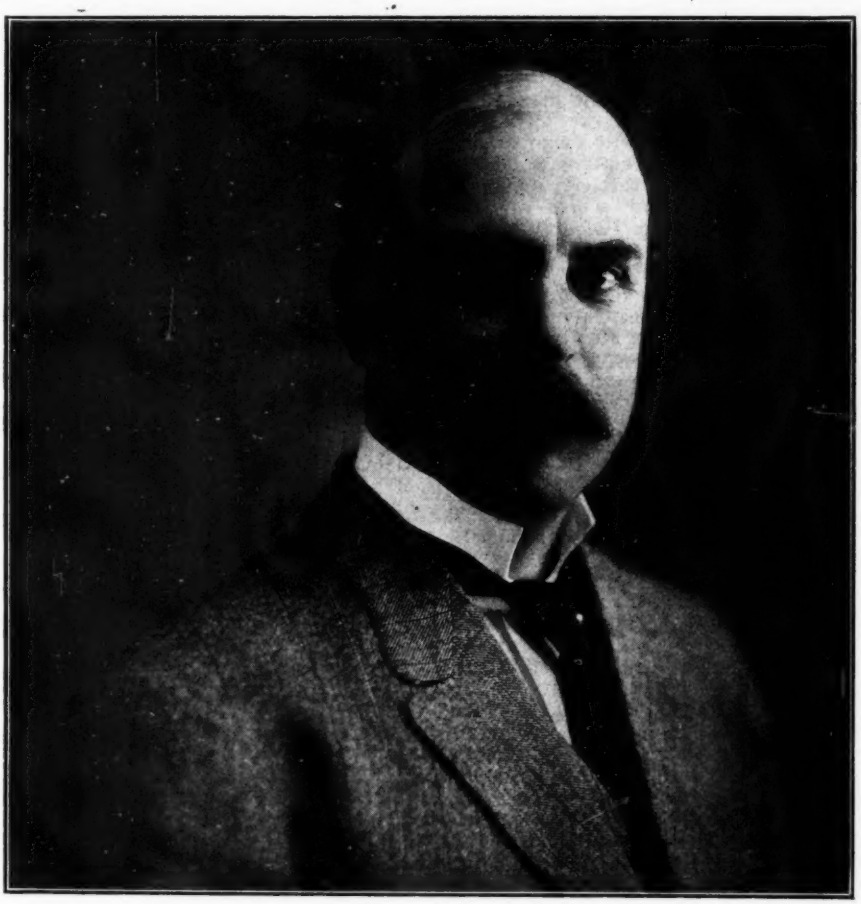
Plans have also been prepared for a comprehensive system of subways to be operated independently of present transportation system. The estimated combined capacity of this independent subway system is 180,000 seats per hour. The estimated cost of these subways, including stations, is $96,200,000. The necessary trackage, electrical equipment, rolling stock, etc., to furnish a complete system, ready for operation, will require an additional expenditure by the operating company of some $35,000,000.

Also the plans for the initial construction of two piers, one for freight and one for passengers and package freight, at a cost of $5,000,000. The piers, when completed, will be 292 feet wide from dock line to dock line, with an 80-foot roadway in the center, on either side of which will be sheds 100 feet wide, the whole

to be constructed of fireproof materials. Between the docks will be water slips 300 feet wide. These, when completed, will be the start of what is considered the most important harbor development contemplated along the Great Lakes.

Owing to the importance of his position, Mr. Ericson has been asked to and has prepared many technical treatises and reports which are of much interest to those engaged in the practice of municipal engineering. These papers cover a variety of subjects, altho one of special prominence is his treatise presented before the Western Society of Engineers in 1911, showing the result of experiments to determine the elements of flow of water in large tunnels.

Mr, Ericson is a member of the American Society of Civil Engineers, American Society of Mechanical Engineers, Western Society of Engineers, and American Water Works Association.



HON JAMES ROLF, JR., *Mayor San Francisco, Cal.*

San Francisco's Mayor

The city of San Francisco, Cal., points to the splendid record of municipal work already accomplished and gives all due credit to her mayor, James Rolph, Jr.

Mayor Rolph's administration has been essentially one of big municipal achievements. He believes in action and has succeeded in permeating the whole city government with his ideals.

Mayor Rolph has mapped out a big program of work for the year 1913. Every phase of municipal developments receives his personal attention.

Nineteen Twelve will be celebrated in the civic history of San Francisco chiefly as the year in which municipal car service was put into operation. The completion of the Geary street municipal railroad and the inauguration of car service at the close of the year was the realiza-

tion of one of the city's fondest dreams, and it gave San Francisco the distinction of being the first of the great American cities to operate its own car line.

Excellent progress has been made upon the auxiliary high pressure water system for fire protection since Rolph went into office, and the records show that sixty-nine miles of pipe out of a total of ninety-one have now been installed.

In this connection the mayor accomplished a big saving for the property owners of San Francisco last year by holding the insurance companies to their promise that rates would be lowered when the system was completed. After a series of lengthy discussions with the board of fire underwriters the mayor succeeded in obtaining an average reduction of 25 per cent., which will mean an annual saving of approximately $1,000,000 to the policyholders of this city.

Three million dollars' worth of land has been purchased for the civic center and an equal amount remains yet to be secured. Despite the fact that a blanket condemnation suit was filed, covering all the land, the city has been able to obtain the necessary property in most cases without resorting to the courts.

Ground plans have been prepared for the entire project, which the architects promise to make a show place of which the city can justly boast.

Giant Sewer Complete

Among the most noteworthy municipal undertakings completed during 1912 is the construction of the North Point sewer, the largest ever built in this city. The huge pipe will afford drainage to 80 per cent. of the homes of the city and will handle the sewage for an area of approximately 11,500 acres. It will cost $1,500,000 and reaches from the county line to the bay, emptying at the foot of Grant avenue. Drainage water was turned in for the first time this week. The monster sewer will do away with the necessity of operating the numerous smaller sewers which now discharge at various points along the waterfront. Its completion will reduce the number of outlets from 125 to five.

During 1912 a total of $5,500,000 has been spent on sewer projects. One of the most important of these is the big storm water relief drain in Division street. A large section of the southern part of the city has been provided with proper drainage. The Forty-eighth avenue sewer, serving the Park, Richmond and Sunset districts, has been completed. Permission to connect the Panama-Pacific Exposition drainage system with the city sewers has recently been given.

The attention of the mayor is devoted largely at present to the solution of the water supply problem. The trip of the officials to Washington in the interest of the Hetch-Hetchy project is expected to be crowned with ultimate success. The administration is still engaged in daily investigations looking toward the acquisition of the Spring Valley Company's plant.

F. G. Simmons

Mr. Fred G. Simmons, commissioner of public works of the city of Milwaukee, received his education in the common schools and collegiate institute of St. Catharines, Ontario, Canada, removing while still a young man to the city of Denver, where he learned the machinist trade. Becoming satisfied that this did not offer sufficient field, Mr. Simmons took a course in civil engineering and in 1888 became connected with the Denver City Tramway Company in charge of roadway and tracks.

In 1897, Mr. Simmons removed to Milwaukee as engineer in charge of the tracks and roadway of the Milwaukee Railway & Light Company, at the instigation of Mr. T. E. Mitten, then general superintendent of that company, and continued with them under Mr. John I. Beggs until April, 1912, when he assumed his present position, that of commissioner of public works of the city of Milwaukee. Mr. Simmons is forty-seven years of age and has been for twenty-five years in active engineering work.

Mr. Simmons has made quite an exhaustive study of the use of the "Tee" rail in street railway construction. While in charge of roadway and tracks in Denver, he appreciated the many advantages of this character of rail as well as the problems it offers when streets must be paved between the rails. Briefly he has the following to say on this subject:

"Practically all engineers in charge of street railway work are unqualifiedly in favor of the use of 'Tee' rail and where an exception occurs it is always in one of the very largest cities of the country. The only cases that have come to the author's knowledge being in New York, Philadelphia and Chicago. In these three cases the engineers all agreed that "Tee" rail was preferable in such places as the team travel was not too heavy on the track portion of the street, but that when a constant stream of vehicles was encountered on this space, a girder or grooved girder type of rail was preferable.

"One of the arguments most insisted on by those who oppose the use of 'Tee' rail is that the paving along the rail is subjected to extreme wear and ruts out with undue rapidity; now, the undue wear

on the street paving along the gage line of the 'Tee' rail is undoubtedly caused, or has been caused in the past, by inadequate methods of laying the paving abutting this point. At no other point on the street can there be any difference in wear whether the rail is 'Tee," girder, grooved girder or any other kind, providing you grant that you are not trying to create a skidway for teams in the construction of a street railway track. The increasing demand for expeditious transit in our rapidly expanding cities would seem to make the team skidway idea ridiculous.

"The paving used in conjunction with all track construction should undoubtedly be of the block or brick variety; the necessity for minor repairs to the track structure making a sheet variety of paving altogether inadvisable. It is the opinion of the author that any engineer urging the use of sheet asphalt paving in connection with street railway tracks is either inadequately educated as to the results to be obtained, wilfully oblivious to the interests of the street railway company or personally interested in the promotion of asphalt paving.

"The method of applying the paving adjacent to the gage line of the rail has been, through the development of the various types of permanent paving, the most difficult one. A prejudice has existed and in some quarters still exists in favor of a groove, either molded or cut in the blocks or bricks, and many arguments are urged in support of this method. I wish, however, to submit the fact that up to the present time it has proven anything but satisfactory. In granite, the best results are probably evident but even here the difficulty of obtaining a smooth and even cutting of the hard material is a serious objection and there is no doubt but that in vitrified brick the result is absolutely disastrous, the sharp edge of the groove wearing away at once and the life of the material at this point subjected to undue wear from the beginning. A new method of treating this gage line proposition is coming to the fore and rapidly gaining favor all over the West and Middle West. This consists simply in depressing the regular block or brick and extending it under the head of the rail at the gage line giving the paving a flat crown between the rails of the tracks. We have adopted this method in Milwaukee and find that it works very well indeed, after about four years of actual experience. It has been adopted in a number of other places with uniformly good results.

"It seems that the chief opponents of the use of 'Tee' rail in city streets are the municipal officers and other engineers in the cities where practically no experience has been had and that practically all those officers and engineers who have had anything like a comprehensive experience with this type of construction are strongly in favor of it. Proper results are often prevented thru the methods employed by the municipalities in laying the paving. I can illustrate this more clearly by telling of how this work has been done in Milwaukee. Under the laws now in force there the kind of paving to be used is finally determined thru petition of the property holders and it is a sad fact that they rarely select the type of pavement best suited to the conditions. The arguments of paving contractors, material supplymen and others are brought to bear and the result usually obtained is political and not mechanical.

"Experience shows conclusively that the use of 'Tee' rail in the permanent paving of city streets is not an experiment altho its use has been given many setbacks thru the selection of improper material and improper methods of installing the paving where 'Tee' rail tracks are laid."

Milwaukee's Non-Partisan Administration

The new administration of the city of Milwaukee, under Mayor G. A. Bading, has now completed a year of work and in making its budget for the coming year reviews its achievements of the past year in the light of its campaign promises.

The bill providing for non-partisan elections of city officials was introduced and endorsed by the administration and was passed.

The policy of the open door to all public business has been carried out excepting as to the printing of proceedings of the board of estimates which are tentative and subject to frequent changes.

The contest for better street car service has been sharp and was transferred to the legislature with respect to some features, with the aid of the State Railroad Commission.

A franchise for a new interurban road has been granted.

The gas inspection bureau has been re-established and the city attorney has done what was possible in the gas rate case before the railroad commission.

The tax rate for the following year will be 17 cents less than last year, it is claimed without restriction of improvements or impairment of efficiency of departments.

The administration is pushing the plans for sewage purification in the face of delays caused by contests of citizens over the location of the plants. A half million for intercepting sewers and purification tanks is introduced in the budget.

The bureau of economy and efficiency has been established on a legal basis.

Two small parks and several playground sites have been purchased.

The council presents a bill to the legislature providing that the city can bid on its own public work.

The harbor commission has been established on a legal basis and a competent secretary appointed.

HON. G. A. BADING, *Mayor Milwaukee, Wisconsin.*

Bad housing conditions have led to the condemnation and removal of one row of insanitary tenements. Child welfare work has been put in the hands of the department of health and a physician has been put in charge.

To an outsider the promises in the platform for the fulfillment of which nothing has been done seem to be of minor importance or to depend upon progress in other lines upon which work is being done.

An ordinance licensing dance halls has been passed.

By appropriating $50,000 for 800 feet of dockage on Jones Island a government appropriation of $316,000 for improvement has been secured.

Automobile apparatus has been supplied for the fire department for the first time.

Some paving by the company between street railway tracks has been secured.

Riparian rights along the lake shore for protection and parkway purposes have been obtained or are under negotiation. Plans for a new water works intake tunnel have been completed. New bridges and viaducts are completed and in prospect. One new market has been established and an appropriation has been made for the enlargement of another.

New work for 1913 and following years is outlined by the bond issues provided for, viz: $500,000 for intercepting sewers and septic tanks; $300,000 for emergency service; $900,000 for schools; $175,000 for bridges; $100,000 for park lands; $50,000 for engine house sites; $30,000 for branch libraries; $100,000 for docks and dredging; $30,000 for the new water works construction; $100,000 for municipal lighting plant; a total of $2,820,000.

Bookkeeping methods have been revised so that the condition of funds is known at all times and cost of any operation is readily obtainable. Salaries have been saved by judicious combinations of duties and reorganization of forces so as to save money in the bureau of purchases, the engineering department, the street repair work, the water waste survey, garbage collection, stone crushing, etc.

Mayor Bading may well be proud of his first year in office and sanguine of the effect of the coming year upon the voters of the city.

QUESTION DEPARTMENT

Effect of Gas on Asphalt Pavement

I am interested in the question of the deterioration of asphalt pavement and would like to find out if there has ever been a series of experiments made to show the effect of illuminating gas leaks upon asphalt pavement.

C., Newark, N. J.

Some desultory tests have been made by confining samples of asphalt in gas. But there have been several reports of practical observation on the subject, which demonstrate clearly the effect, for what seems to be a good reason.

In MUNICIPAL ENGINEERING there is an article on "Causes and Prevention of Defects in Asphalt Pavements" in vol. xxxvi, p. 307. In vol. xxix, p. 429, is an article which refers also to reports from Utica, N. Y., in vol. xx, p. 37; Brooklyn, N. Y., in vol. xi, p. 297; and Washington, D. C., in vol. xxi, p. 415. There is also an article in vol. xxiii, p. 212, which makes the statement, which is repeated in one or more of the other articles, that it is the hydro-carbon enrichers which produce the disintegrating effect and gas which has not been enriched has much less effect upon the pavement, or may not have any.

Ordinance on Destruction of Weeds

Can you cite me to a good ordinance covering the subject of weeds, providing that property owners shall keep their property and vacant lots free from weeds, and also the ground adjacent to the sidewalks and to the center of the street, etc.?

B., City Attorney, ———, N. M.

The ordinance in force in a city of 250,000 population, first declares that the growth of weeds or noxious plants within the city is injurious to public health and within the limitations of the ordinance is a nuisance; and that it is unlawful for the owner of any lot or ground within the city to allow the same or any street or alley upon which said lot abuts to become overgrown with them to an extent that in the opinion of the Board of Health, is detrimental to public health and comfort.

It then provides that the sanitary officers shall make inspections from time to time and report names of owners of lots on which or on streets or alleys on which the lots abut, weeds have been permitted to grow. The board then investigates and may declare the weeds a nuisance to be abated and destroyed. Written notice is served on each owner or his agent, directing the cutting and burning of the weeds. Notice to unknown or non-resident owners is made by publication twice in two weeks. If the owners fail to observe the notice within the time set in it, ten days from time of service or last day of publication, the board must order the work done by its own employes. The board certifies the cost to the city comptroller, who places it on the tax duplicate as a lien to be collected, as are assessments for sprinkling and sweeping streets.

Failure to comply with the notice is also made a misdemeanor subject to $50 fine.

Form of Ordinance for Public Improvement in Illinois

Last year we put in a cement sidewalk and two property owners did not build within the thirty days allowed them by the ordinance, and the city built and made the levy for the special tax thru the county collector's office, to which the said property owners filed objections. The county court overruled the objections, but our Supreme Court sustained them on the ground that the notice given them to build was between the time said ordinance was passed by city council and time of its publication. Now, we have Section 296c of Chapter 24, of our Revised Statutes of Illinois, being the last section of the sidewalk act, which provides that where tax is set aside by a court, a new ordinance may be passed, etc., for work already done, etc. Have you a model ordinance for this new ordinance for the levying of the special tax for work already done? If so, would be pleased to have a copy of it or information to draw one.

W., City Attorney, ———, Ill.

The procedure under Illinois statutes is so complicated and is so indefinitely

laid down that even the courts cannot agree about it, as demonstrated in the question.

Some years ago the National Paving Brick Manufacturers' Association, recognizing the difficulties, prepared a book of forms for all stages of the passage of a public improvement from petition to payment of assessments. Most of this book is still of use, altho some changes have been made in the statutes since it was issued. Perrhaps a copy can be obtained by addressing W. P. Blair, secretary, Locomotive Engineers' building, Cleveland, O.

Books on Reinforced Concrete Dam and Wall Construction

Can you recommend a handbook covering reinforced concrete construction of retaining walls, dams, etc.?

W. A. S., Newnan, Ga.

Chapters in Taylor and Thompson's "Concrete Plain and Reinforced" ($5) and Buel and Hill's "Reinforced Concrete" ($5) are devoted to this subject. The former contains lists of articles in engineering periodicals descriptive of many such structures. Webb and Gibson's "Reinforced Concrete" ($1) contains a brief theoretical analysis of the reinforced concrete retaining wall. Mensch's "Reinforced Concrete Construction" ($2) has brief discussions of both forms of structure. Gillette and Hill's "Concrete Construction Methods and Cost" ($5) has brief descriptions of methods of construction.

Earnings of Public Utility Corporation

Can you refer me to any data concerning the earnings of public utility corporations, both in this country and in other countries, particularly Europe?

I have not been able to lay my hands on any such data for Europe, except what is contained in the 1907 report of The National Civic Federation.

F., Denver, Colo.

The "Manual of Statistics" ($5), published by The Manual of Statistics Company, 20 Vesey street, New York, is an annual volume which gives more or less complete figures regarding the operation of railroad and industrial corporations, among which are many public service utilities.

Such newspapers as the following give reports from such companies as desire to sell bonds or stock: Daily, *Banker and Stockholder*, $25 a year; *Bond News*, $84; *Bond Buyer*, $120; weekly, $12; *Shareholder*, semi-weekly, $4.

Dealers in securities of such companies have access to circulars giving statements of results of operations of such companies, and distribute them among prospective investors. Such operators of public service industries as Stone & Webster, issue periodical statements of their companies for the benefit of investors.

The annual reports of the Massachusetts Gas and Electrical Commission and of the Public Service Commission of the First and Second Districts of New York, contain detailed statements of the financial operations of the public service companies under their supervision.

The special reports of "Financial Statistics of Cities of over 30,000 Population," made by the U. S. Census Bureau give total receipts and expenditures of public service industries under municipal ownership.

The "Municipal Year Book," published by Edward Lloyd, Ltd., 12 Salisbury Square, London, E. C., England, gives brief statements of capital and revenue accounts of water, gas and electric works and tramways owned and operated by municipal corporations in Great Britain and Ireland.

Will our readers refer us to other sources of the information desired, particularly with reference to other countries?

Water Rates

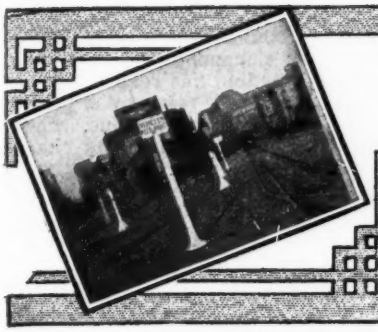
I desire to obtain information relative to water rates in the United States as charged by the different cities and towns, and the water companies. I am told that you have published such information in your magazine.

A. A. F., Pittsfield, Mass.

The best collection of water rates published is that in the Manual of American Water Works, which was published in 1897, although it is somewhat out of date in respect to a good many plants. It can be obtained for $1.50.

A number of collections of water rates have been published in MUNICIPAL ENGINEERING. In vol. xlii, p. 190, is an article giving the range of water rates in Pennsylvania cities. In vol. xli, p. 131, is an article giving the water rates in a large number of the smaller cities in Indiana, Ohio and Illinois. In vol. xl, p. 103, is a general article on water rates; on p. 120 is one giving the rates for sprinklers and standpipes for fire protection; on p. 319 is an article on the principles of rate making. In vol. xxxix, p. 208, is an article giving rates in cities served by gravity systems; on p. 209 is one giving rates for laying macadam; and on p. 120 is an article giving rates in a number of Connecticut cities.

Mr. Dow R. Gwin made a collection of water rates, which was published in the Proceedings of the American Water Works Association and can be obtained from the secretary, Mr. John M. Diven, 47 State street, Troy, New York.



WORKERS IN THE FIELD

Cement Required for Curb, Gutter and Street Foundation

The Editor of MUNICIPAL ENGINEERING:

Sir—Having recently had occasion to estimate the amount of cement required for some paving and curbing work of various kinds, I have averaged up the daily inspectors' reports from several jobs of which I have had charge, to arrive at a practical unit of cement for each unit of work actually constructed.

As the data may be of use to some of your readers, owing to the fact that the amount of cement actually used differs materially from the amount indicated by a calculation, I submit the results, as follows:

A job of straight 6x20-inch concrete curb, built of one mix concrete, one part cement, two parts sand and as much gravel or crushed stone as could be readily bedded, used 0.2 sack of cement to each lineal foot of curb.

A job of one coat 6-inch concrete paving, one part cement, two parts sand and four parts crushed stone, used 0.985 sack cement to each square yard.

A job of combined curb and gutter, consisting of a 6x12-inch curb, joined to a gutter 36 inches wide, 6 inches thick at its junction with the curb and 8 inches thick at its junction with the pavement, made of one mix concrete, one part cement, two parts sand and four parts crushed stone or gravel, used 0.472 sack cement for each lineal foot.

A job of paving foundation 4 inches thick, of concrete, one part cement, three parts sand and four parts crushed stone or gravel, used 0.518 sack cement to the square yard.

A job of combined curb and gutter, consisting of a 6x12-inch curb, joined to a gutter 36 inches wide and 6 inches thick, made of one mix concrete, one part cement, two parts sand and four parts gravel or crushed stone, used 0.46 sack cement per foot.

Another job of paving foundation, 4 inches thick, under same specifications as above, used 0.46 sack cement to a yard.

THEO. S. DELAY, C. E.,
Creston, Ia.

Eugene, Ore., Municipal Light and Water Plant

By Alvin Meyers, Electrical Engineer.

The past year has seen the completion of the municipal street lighting system, and large extensions of the municipal water system. The city of Eugene now has over half a million dollars invested in these public utilities, and is serving the whole city with water and with electrical power and light.

The generators, water wheels, switchboards, and step-up transformers are housed in the main building, which is of corrugated iron 90 feet by 40 feet. The main line circuit breaker and the arresters are located in a separate high-tension room, 24 feet by 36 feet, just back of the switchboard. Foundations are of concrete, 24 feet deep, in a gravel and rock formation, and are adapted to the reception of a brick building later.

The generating plant consists of two units, each made up of a 1,200-b.h.p. Pelton-Francis type turbine, direct connected to a 2,300-volt, 60 cycle, 3 phase Fort Wayne alternator, having a normal rating of 945 h.p. (705 k.v.a. at 300 r.p.m.). Each generator has an overload capacity of 25 per cent or 1,180 h.p. (875 k.v.a.) for 2 hours.

With the addition of another bank of transformers the maximum continuous capacity will be 2,000 h.p. at the generator terminals.

Two 40 h.p. (30-kw.) Ft. Wayne exciters are in operation, each one belted to the shaft of its respective generator. The hydraulic head on the shaft centers of the wheels is 28 feet, and the draft head is 15 feet, giving a total head of 43 feet.

At the close of construction each unit was tested out separately to the capacity of approximately 1,000 h.p. on artificial loads. While the tests were in progress, switchboard readings, smooth operation of the machines and freedom from heating indicated that the guaranteed performance and efficiencies of the manufacturers had been satisfactorily met.

The maximum load on the station in October, 1912, during various times

reached 550 h.p. This means that in ten months of commercial operation over ¼ of the ultimate, and about ½ of the present station capacity, has been used.

The power distributed from the city substation is used for pumping city water, street lighting, and commercial light and power service.

For pumping the power is delivered at 2,300 volts to an adjacent building, where the pumps for the city water works are located.

The street lighting equipment is located at the substation. It consists of two 20-h.p. (16-kw.) 6.6-ampere regulators, which operate the street lights through two circuits. One circuit covers the north and west portion of the city, while the other circuit furnishes the south and east portion. This arrangeemnt permits of continuous extensions which are in progress, the first plan being to cover the city with at least one 100-watt series tungsten lamp at every block corner. Thirty miles of streets are now lighted by this system. The lamps are usually mounted by means of pipe brackets on poles at the street intersections and at a height of about 15 feet above the curb.

The commercial service is furnished by two 2,300-volt, three-phase circuits, carried overhead on poles. The circuit for the north and west and business section of the city is of No. 0 copper with a load center at about 3,000 feet from the substation. The circuit for the south and east part of the city leaves the substation underground for a distance of 500 feet, and then changes to overhead construction. The standard secondary voltages are 230 volts three-phase for motor service, and 230-115 volts for lighting service.

Customers' service is metered thruout excepting such service as is fixed in regard to the amount and hours of use, as in case of sign and window lighting.

The lighting of the business section with ornamental cluster lights is now in process of installation. Five-light posts are used with four pendant 60-watt tungsten lamps, and one vertical 100-watt lamp. Pendant lamps are enclosed in 12-inch roughed glass globes, and are turned out at midnight. The vertical lamps are enclosed in 14-inch glass and burn all night. Energy is furnished from the 230-115 volt three-wire commercial system. The wires are carried in steel conduit laid in the cement walk next to the curb.

The subject of reduction in rates caused by the municipal electric plant entering the field has been touched upon. Again briefly stated, this reduction has benefited the city of Eugene, but the neighboring city of Springfield has reaped some of the fruits of reduced rates to a partial extent. In the city of Eugene, where heretofore the maximum lighting charge was 15c per kilowatt hour, the maximum rate now charged is 9c per kilowatt hour. In other words, when the city plant entered the commercial field just a year ago the maximum lighting rate published by the city was the 9c rate above referred to. The corporation furnishing electrical energy in the city of Eugene finally met the city's rate, after three separate and distinct reductions.

It is perhaps not generally understood by the average citizen what patronage means in reducing the unit cost of the production of electrical energy. The fact is well recognized, that a large number of kilowatt hours can be produced at the same cost as a small number of kilowatt hours. Hence the cost per kilowatt hour reduces rapidly with increased patronage.

Loyal support and constantly growing patronage will have only one result, that is, cheaper cost per unit, and as patronage increases consequent further reduction in rates is the inevitable result. The rates for consumption of electrical energy, as shown herewith, are the result of careful consideration of all the problems pertaining to rate making.

SCHEDULE OF RATES FOR POWER AND LIGHTING SERVICE AS ADOPTED BY THE EUGENE WATER BOARD.

Lighting Service.

	Cts. per kw. hr.
20 kilowatt hours	9.0
40 kilowatt hours	8.0
100 kilowatt hours	7.0
230 kilowatt hours	6.0
500 kilowatt hours	5.0
1,300 kilowatt hours	3.0

Intermediate kilowatt hours at intermediate rates. Minimum monthly bill, $1.

Power Service.

100 kilowatt hours	5.0
150 kilowatt hours	4.5
230 kilowatt hours	4.0
380 kilowatt hours	3.5
800 kilowatt hours	3.0
1,300 kilowatt hours	2.75
1,900 kilowatt hours	2.50
5,000 kilowatt hours	2.25
10,000 kilowatt hours	2.0

Minimum monthly bill 75 cents per horsepower of maximum demand.

Conservation of Water Resources For Inland Navigation

By Albert H. Scherzer, Chicago, Illinois

The national wealth of the United States during the time of the first President was less than $1,000,000,000, yet sufficient for the defense of the United States. The national wealth had increased to about $10,000,000,000 in 1850, to $16,000,000,000 in 1860. The public debt then was less than $60,000,000, and the population had grown to nearly 32,000,000.

During the period from 1861 to 1865 more than 2,000,000 men were employed in military service, requiring salaries and expenses about $3,000,000,000, nearly 20 per cent. of the national wealth. One million lives were sacrificed. The expenditures, including interest and pensions up to 1913, were more than $16,000,000,000. To this should be added the property devastated and the limitation in production for a number of years.

These facts are stated here to illustrate the great cost of war and the great financial strength of a comparatively small population 50 years ago, in order to form a conception of the very great financial strength of the United States Government at the present time for constructive work in the line of its duty for the welfare of the people.

Valuable Private Constructive Work

The greatest visible construction work for the welfare of the people has been performed by private enterprise in building the railways on which about $16,000,000,000 has been expended, less than the cost of the Civil War, but the construction of the railways aided the United States to recover more quickly from the destruction between 1861 and 1865, so that today, after nearly 50 years of united upbuilding, the obligations of the Government remaining are virtually confined to the pensions.

The national wealth now exceeds $130,000,000,000. To this must be added the energy represented by 95,000,000 united intelligent people. No government has ever had so great an accumulation of natural resources, intelligence and financial energy at its command. There is now no desire of the people and, in fact, no opportunity to direct the great money energy of the Government into expensive warfare with any nation.

If only 1 per cent of the national wealth, $1,250,000,000, is expended during the next ten years in construction work by the United States Government for the welfare of the people, the beneficial results will endure for centuries and be clearly apparent to the people. If 20 per cent of the national wealth could be appropriated 50 years ago in hazardous and destructive warfare, 20 per cent. of the national wealth can be safely appropriated during the next 20 years for purposes of construction and only result in a very great increase of the national wealth and public welfare.

Federal Constructive Duties

In the life of a nation it may be necessary to have a brief time of destruction or warfare, but the greater part of a modern nation's life should be employed in constructive work.

The Federal Government has constructive obligations to perform as well as the smaller organizations, the municipalities, counties and states. Everywhere we see the wonderful constructive activity of the individual citizen exhibited in the improvements of lands, construction of homes and multitudes of other constructive works. The same is true of many private corporations who exhibit a great and ever-increasing constructive activity for the welfare of the citizen.

Cities Have High Constructive Record

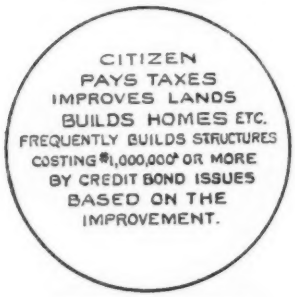
Municipalities governed by a mayor and aldermen with limited powers are obtaining revenue by various forms of taxes and in many cases devoting more than 90 per cent. of the revenue collected for constructive work for the direct welfare of the people.

Municipalities in the United States annually appropriate large sums for schools and schoolhouses, water works, sewers, improved streets, parks, electric lights, libraries and many other beneficial constructive work. Undoubtedly perfection has not yet been reached either in the intricate municipal taxation levies or in the expenditure of the revenue collected, but the results visible everywhere from having developed a definite constructive purpose and system for the welfare of the taxpayer are very surprising when contrasted with the comparatively small visible results now received by the people from their greatest constructive organization and center of monetary wealth, the Federal Government.

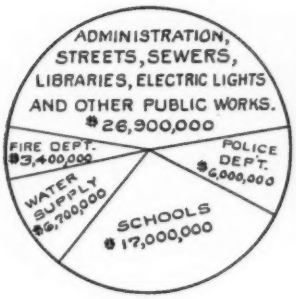
Federal Constructive Record Undeveloped

Only about 14 per cent of the more than $600,000,000 taxes annually raised by the Federal Government is devoted to construction, including the Panama Canal. About 70 per cent. goes to the three items, army, navy and pensions. The postoffice being virtually a self-supporting business is not included in these items. Within a year the Panama Canal will be finished and unless some plan for constructive work is ready the percentage devoted to construction will become still less. Here is a great opportunity for improvement to benefit the entire people. No city or state has at its service as great ability as the

Three Records Compared



The Good Citizen's Record
The good citizen's record averages about 70 to 90% constructive


ADMINISTRATION, STREETS, SEWERS, LIBRARIES, ELECTRIC LIGHTS AND OTHER PUBLIC WORKS. $26,900,000
FIRE DEPT. $3,400,000
POLICE DEPT. $6,000,000
WATER SUPPLY $6,700,000
SCHOOLS $17,000,000

A Typical City's Record

Annual taxes of $60,000,000 expended principally for constructive purposes.

City, County and State authorities average about 70 to 90% constructive for the welfare of the taxpayer.

Mayor and aldermen or city authorities have a limited constructive opportunity and revenue, but in modern times have developed a comparatively high constructive record.

The Federal Record

Constructive record only about 14% of the more than $600,000,000 annual taxes.

The Federal Government represents 95,000,000 people and the national wealth of more than $130,000,000,000.

The President, Senators and Congressmen have great ability, a large constructive opportunity and great money resources to be used for construction.

The Panama Canal will be completed in 1913 and if no comprehensive constructive plan is ready the constructive record may be much less than 14%.

United States Government. Ability, energy and money can be directed either toward construction or destruction.

Intricate local taxation and tariff questions requiring discussion and adjustment do not suspend municipal improvements and tariff discussions should not suspend plans for Federal improvements. The amount a modern government appropriates for constructive work should greatly exceed the amount it appropriates for destructive purposes. If the Federal Government expends only a part of the energy during the next 50 years in constructive work that it expended 50 years ago on work necessarily involving destruction, many lives will be saved and the direct returns and benefits to the people will be very great and permanent.

Water the Great National Property

The principal constructive duties entrusted to the United States Government are those relating to the improvement of the great rivers and harbors of the United States for maximum service and usefulness. The rivers represent great rights of way covered by water, one of the most valuable, useful materials in the world, but when not confined to definite, useful channels water becomes very destructive and wasteful to life and property. The control of the Mississippi and other great rivers of the United States is a primary Federal duty, as these rivers extend thru many states and carry interstate, international and intercontinental commerce. The Federal Government alone has the authority, money resources and ability at its command for the proper construction of these great works entrusted to it by the people.

The deepening, straightening, improvement and regulating the outflow of the great rivers of the United States to obtain their maximum service for the benefit of the people will more than double the present national wealth of $130,000,000,000, and the cost of performing this work will be but a small fraction of the direct financial returns.

Control Not More Difficult Than Building Large City Waterworks System

The active performance of this duty by the United States Government is no more difficult than it is for a city to build an adequate useful water works system for the benefit of its citizens and at the same time construct improved streets, schools and many other public works for the public welfare. If cities can do so much for the public welfare it is evident the improvement of the great rivers and harbors of the United States need only employ a comparatively small part of the constructive energy, ability and vast money resources entrusted to the United States Government. Using a comparatively small part of the great money energy of the Federal Government to control and develop the great National property, water, for maximum usefulness will more than double the National wealth, the wealth of individuals and corporations.

Road Building in Michigan

By J. B. McArthur, Road Commissioner Sheboygan County, Sheboygan, Mich.

Jurisdiction over county roads in the state of Michigan is vested in the boards of county supervisors of the respective counties, and jurisdiction over township roads is vested in the commissioners of highways of the respective townships. The board of supervisors of any county may submit the question of adopting the county road system to the electors of said county and if same is adopted a board of county road commissioners consisting of three members shall be elected by the people of the county to have jurisdiction over all road matters in said county.

The commissioners of highways of each township may levy annually for highway purposes, a road repair tax of not to exceed 50 cents on each $100 of assessed valuation, and a tax for highway improvements of not to exceed 50 cents on each $100 of assessed valuation, the rate of levy to be fixed by the electors at the annual township meeting. On a vote of 60 per cent. of the legal voters of a township, the township board may issue bonds for road purposes not to exceed 5 per cent. of the assessed property valuation in the township.

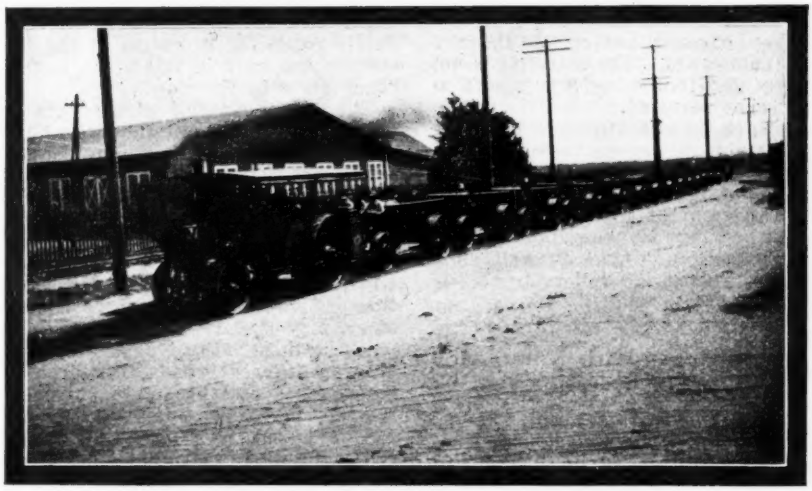
In the counties adopting the county road system, a tax for road purposes may be levied by the county road commissioners of not to exceed 2 mills on each $1 of valuation. Such counties may issue bonds not to exceed 3 per cent. of their taxable valuation.

We have constructed considerable water bonded macadam and gravel roads. In 1912 we constructed several miles of stone and gravel roads and during 1913 will probably build considerably more of this type than we have ever laid in previous years.

There is no doubt but that gravel roads comprise more than 90 per cent. of the total mileage in the United States and it is quite important that they not only be efficiently and economically constructed but that they be maintained in good condition and at the smallest possible expense for travel at all seasons of the year.

Roads of the above type must be well drained and properly crowned in order to be serviceable at all times. In order to be properly drained they must have the proper longitudinal grade; a minimum grade of 0.5 per cent., with a maximum grade of 5.0 per cent., which may be increased, depending upon the amount of traffic and the obstacles met in locating. The minimum grade is necessary in order to give the side ditches the proper amount of fall to carry the water quickly and rapidly along and away from the road. The side ditches should be built of a sufficient width to carry successfully all of the water coming into them, having side slopes of 1½ horizontal to 1 foot vertical, which will prevent the earth from the side caving in either from excessively wet weather, or from freezing and thawing.

Among the many things extremely vital to the building of highways are improved methods and better machinery for doing the work. The engineer and public works official are interested in this part of the subject, entirely from the viewpoint of obtaining lower prices for their work; the contractor in order to make



PORT HURON TRACTOR *and train of Dump cars in use on Michigan roads.*

profit, which being increased, means lower prices on subsequent work. Thus the incentive of each means a saving to the taxpayer, more roads for the same money.

The spreading dump wagon should be more generally used because it materially decreases the cost of spreading stone and makes it possible to do the work in much quicker time and for considerably less money. We own and operate twelve Port Huron spreading wagons which evenly spread and distribute the material. Compared with self-dumping and non-spreading dump wagons these machines save in spreading alone 2 to 3 cents a cubic yard and as compared with shoveling from the wagon they effect a saving of about 5 cents per cubic yard. The material is not only evenly distributed but it is placed at the exact spot required.

In our work we operate aside from the twelve spreading wagons, two traction engines, six dump wagons and two water wagons, all of the Port Huron type. In order to carry on the work most successfully, this spring we contemplate purchasing a traction engine as well as a combination tractor and roller.

THE EMERGENCY SQUAD *with motor transportation repairing a road in Shelby County, Tennessee.*

Repairing Roads with Emergency Squad

By Thos. B. King, Chairman Shelby County Road Commissioners, Memphis, Tenn.

Following the lead of the City of Memphis, Shelby county shook off the shackles of an antiquated and inadequate form of government and inaugurated Commission Government last year.

The commission meets on the first Thursday of each month. All meetings are public and everyone is always cordially invited to attend these meetings, including all called meetings. While the commission is in session almost daily, the public can always find one, and most of the time three commissioners in their office in the court house.

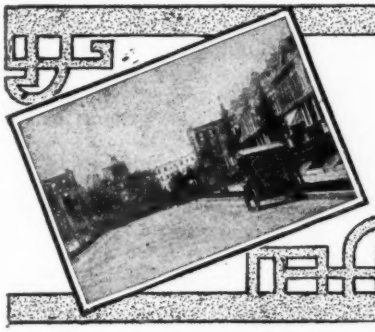
There are now 626 miles of pikes in Shelby County and 700 miles of dirt roads which have been graded and worked under a special act of the legislature, making a total mileage of what may be called public roads far in excess of the average county, not only in this state, but in any other state in the South.

The accompanying picture shows the emergency squad of the workhouse at work on the roads in Shelby county.

The duty of this squad is to repair the most needed places in the turnpikes and to replace small bridges and culverts that have been washed out by late rains.

The county owns the truck, and each day the superintendent, under the direction of the commissioners, sends this emergency squad to open ditches, to repair the most needed places and to travel over different roads in search of the bad washes and broken-in culverts with instructions to repair as they go.

This is rather a new feature in road repairing, and is thought by the commissioners that it will be enlarged until much of the repair work will be done in this manner.



ROADS AND PAVEMENTS

Congestion of Traffic on Fifth Avenue, New York

The Fifth Avenue Association made a special study in December of the traffic conditions on the avenue between 27th and 49th streets, and at the crossings of 27th, 32d, 34th, 42d and 45th streets. The study was limited to the hours of greatest congestion, 2 to 6 p. m., and was made the basis for recommendations of ordinance provisions for the regulation of traffic on the avenue and of suggestions for handling traffic at the street intersections.

The traffic census and the study of management were made by J. Bernstein, C. E., under the direction of the officers of the association, of which Robert Grier Cooke is president.

The census was made with special reference to the problems of handling traffic at street intersections and along curbs and took account of passenger and business vehicles, motor-driven and horse-drawn vehicles, omnibuses, heavy trucks and light vehicles, northbound and southbound on Fifth avenue, and turns to the left, on the first day. Later counts were made of the passages of hacks cruising around looking for fares, of empty vehicles and of the times traffic was halted at street crossings and average time lost, and at two places the number of turns of vehicles in the middle of a block were counted. Similar counts were made on one day each at the principal cross streets above named.

The following table gives the totals at each of the points of observation, which were located in each case on Fifth avenue, between the street named and the next street north; the first column giving the total movement of vehicles each way, the second and third the movement of passenger vehicles, in the second, northbound and the third southbound, and the fourth and fifth the movement of business or freight transfer vehicles, in the fourth northbound and in the fifth southbound.

Movement of Traffic on Fifth Avenue, New York.

		Passenger Vehicles		Business Vehicles	
	Total Both Ways	North Bound	South Bound	North Bound	South Bound
27th ..	5,123	2,817	2,129	66	71
32d ...	6,362	3,493	2,653	78	138
34th ..	6,978	3,913	2,759	150	156
36th ..	6,372	3,214	2,942	91	125
42d ...	9,229	4,620	4,184	134	291
44th ..	8,463	4,383	3,835	93	152
45th ..	10,048	5,167	4,621	70	190
47th ..	8,619	4,630	3,597	158	234
48th ..	8,224	4,343	3,363	257	261

It is evident that the number of business vehicles is comparatively small, but the omnibuses are included in the passenger vehicles.

Motor-driven vehicles almost equal the number of passenger vehicles, being usually between 300 and 400 less running north, and between 200 and 300 less running south, except above 47th and 48th streets, where they are less than 100 apart in each direction.

The number of omnibuses ranges from 110 each way above 27th street, to 182 above 47th and 48th streets. The number of heavy trucks varies from 10 each way above 27th street to 182 northbound and 132 southbound above 48th street, the southbound trucks being in the majority except at the stations farthest north and farthest south. The number of light vehicles counted at each station is very nearly that of passenger vehicles, being usually much less than a hundred smaller.

Turns to the left, that is, so that the vehicle must cross the stream of traffic, were counted. They vary during the afternoon from 281 to 52, the turns from the side streets on to the avenue being materially the larger in number, except at the stations above 27th, 32d and 44th, where the difference the other way is very pronounced.

Empty vehicles were counted at about

half the stations and averaged nearly 300 per hour in both directions, nearly two-thirds of them being southbound.

Traffic was halted on the avenue from 23 to 48 times per hour for an average of 22 to 73 seconds each time. The longest stoppages were for the 34th street crossing, averaging more than one minute for each stoppage thruout the afternoon. Those at other crossings averaged not far from a half minute each.

The hourly variation of the traffic was considerable. In most cases it was greatest between 3 and 4, but for stations below 35th street the maximum was between 4 and 5 o'clock.

Travel across Fifth avenue at the cross streets named is ordinarily less than one-third that along the avenue at the same points, running less than one-fifth at 45th street, where the north and south traffic was the maximum observed. Traffic is held up much more seriously, however, the delays averaging much more than one minute for each stoppage and approaching two minutes in two hours at two crossings.

These observations, the general evidence of which, only, is given here, have led Mr. Bernstein and the Fifth Avenue Association to make several recommendations, which have to do with the several smaller classes of vehicles named above, the observations having demonstrated that these small percentages of the total numbers produce a large part of the congestion.

Thus business vehicles, while sometimes less than 1 per cent. of the total traffic, but occasionally as much as 11 per cent. of it, produce by their presence a cause of delay which is out of all proportion to their number. It is proposed, therefore, to keep business vehicles off the avenue between 2 and 6 p. m., except on the block on which such business wagon must make an emergency delivery. Heavy trucks loaded with building materials, coal, furniture, etc., are included in this list.

The empty vehicles going south are notable in the observations, mainly chauffeurs going for their employers, and they should be turned to parallel streets. Likewise public hack drivers should not be permitted to cruise up and down the street with empty vehicles but should be given stands on side streets.

Empty carriages and motors at the curb seriously delay traffic, because they interfere with the receipt and discharge of passengers by the omnibuses. A recommendation similar to the Birmingham ordinance is made; that 25 feet of the curb at northeast and southwest corners be kept clear so that the omnibuses can exchange passengers at the curb. Also drivers should be required to take empty vehicles to side streets while waiting for their passengers.

Turns in the middle of the block should be prohibited.

The stoppages of avenue and street traffic should be timed in proportion to the amount of traffic.

One interesting recommendation is for a simultaneous movement of traffic for six or eight blocks by means of mounted policemen whose signals could be seen by three or four corner men each way. The operation of this recommendation would seem to promise too great delay of cross traffic and a serious demand would then arise for some such separation of traffic at congested crossings like 42d street by means of partial elevation and depression of the streets to separate the grades at their crossings, as has been suggested and illustrated in the local newspapers.

The report gives the Fifth avenue side of the case and the side of the cross street traffic must be considered before final action is taken.

Why Some Bridges Fail

The March floods in Indiana and Ohio thoroly tested the methods of planning and building bridges, showed the weak spots and the economy of full allowance for the maximum floods in providing waterway thru the bridges. The accompanying photographs show so clearly some of the defects in design which resulted in failure that but little additional comment is necessary.

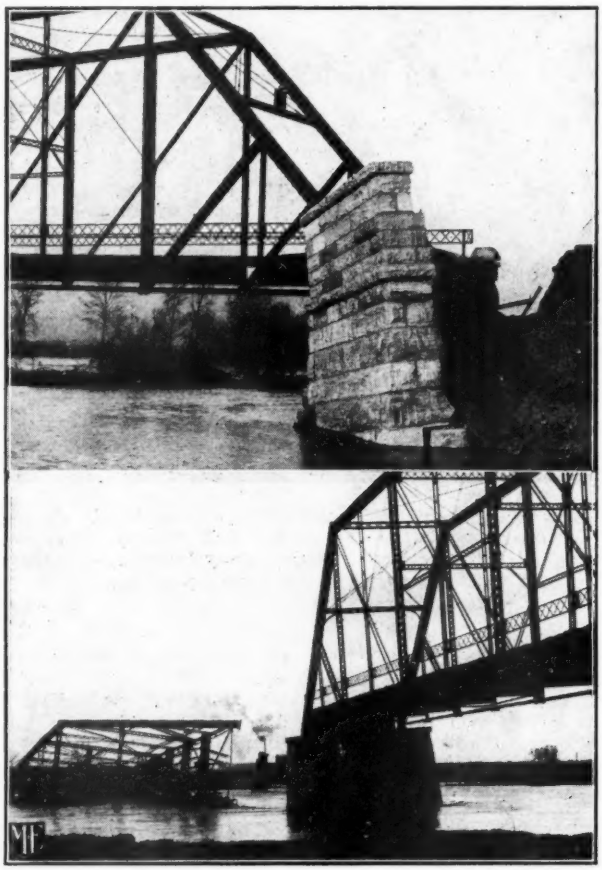
The photographs of the Meridian street bridge on pp. 24 and 64 of the April number, show the serious effects of narrowing the channel so as to reduce the horizontal dimension of the cross-section. This bridge of three spans was barely sufficient to carry the water coming to it, as shown by one photograph taken before the flood had quite reached its height. The access of the water to the south (left hand) span was restricted by the construction of the boulevard retaining wall shown in another photograph, which caused a difference of level between the water in this span and the others enough to concentrate a scouring flow in the constricted area. The horizontal dimension being short the water attempted to increase the vertical dimension to compensate. The result was the undermining of the first pier from the south for nearly half its length. When the tree seen in part in two of the photographs struck the pier, this action was increased and the pier slid into the excavation, breaking in two as seen. The arches were of concrete reinforced on the earlier Melan plan with steel I-beams and there was no transverse reinforcement. Consequently the concrete sheared off neatly along a

KENTUCKY AVENUE BRIDGE, *Indianapolis, over White river, after the flood. Fill behind abutment and street pavement washed out and abutment undermined and damaged. Note strength of pavement of street railway tracks.*

reinforcing beam on the line between the solid and the moved parts of the pier, leaving the lower half of the bridge in as good condition as it had ever been. The retaining wall was also undermined to some extent, only the lower portions of it, with insufficient foundation, dropping into the creek. These parts were located above the constriction of channel. The gravel washed from the bed of the stream was deposited under and just below the bridge arches, where the current was reduced in velocity by the increase in width of cross-section and the discharge could be taken care of by the wider and shallower form of cross-section. This is seen in the accompanying photograph which shows the debris from the arch deposited in and on the gravel bank formed underneath it. The twisted I-beam shows how the arch revolved about the attachments to the piers, the crown turning bottom upwards next to the face.

The Washington street bridge is an instance of the use of a deck girder instead of a thru girder for the convenience of the travel over the bridge, which resulted at highest flood stage in an approach to a dam across the river with insufficient flood gates open thru it. When debris

MERIDIAN STREET BRIDGE, *Indianapolis, over Fall creek, after the flood. Preparing to remove the damaged section. Note twist in some of the I-beam reinforcement of arch, also gravel and debris deposited under bridge.*



HARDING STREET BRIDGE, *Indianapolis, after the flood. Lack of wing walls and insufficient foundation for abutment.*

RAYMOND STREET BRIDGE, *Indianapolis, after the flood. Insufficient foundations for piers and abutments; no wing walls.*

landed against the bridge and still further restricted the discharge under the bridge, the structure was pushed out of place, carrying all of two piers and part of a third with it. Only one span, at the west end out of the maximum flow of the current, remains. A sharp bend of the river, at this place, which threw the current against the east bank and caused an eddy on the lower side of the bridge added to the destructive effect. This is indicated and the increasing tendency to scour toward the east end (left foreground) is shown by the difference in level of the water on the west and east sides of each pier.

Three of the bridges shown are old steel girder bridges built twenty or more years ago. They show the defects of many bridges built too cheaply, in insufficient foundations of piers as in the Raymond street bridge; absence of wing walls and lack of protection of abutments against scour as in the Harding street and Kentucky avenue bridges. The current got behind the abutments in each of these bridges and damaged them tho it did not destroy them. The strength of the street railway track is shown in the picture of the Kentucky avenue bridge. The fastening of the rails to the ties, the strength of the tie rods between rails holding the pavement between the rail flanges, and the adherence of concrete and cement filler to ties and rails, has kept the pavement, including the concrete foundation intact, so far as the street railway company's part is concerned, tho

the pavement of the remainder of the street at this point has disappeared.

The Thirtieth street bridge at Riverside Park and across White river did not fail. Much water passed round this bridge on both sides and it is possible that it could not have carried all of the discharge of the river, but it stood the pressure to which it was actually subjected without injury. Wing walls, abutments and foundations were ample in this modern reinforced concrete arch bridge.

WASHINGTON STREET BRIDGE, *Indianapolis, over White river, before the flood reached its height. Note differences of elevation between two sides of each pier, caused by bend in stream throwing current to east bank and impossibility of making piers conform to current direction thruout.*

Standard of Abrasion for Paving Brick

The organizations of city officials interested in standardizing paving specifications adopted a standard rattler for making abrasion tests and standard methods of making the tests but did not see fit to specify the maximum allowable amount of abrasion until a year or so ago. After two or three trials the specification has been set at 22 per cent. with proviso in the specifications of the American Society of Municipal Improvements that "where medium or light traffic or other conditions exist which, in the opinion of the engineer, do not require a brick capable of giving an abrasion loss of only 22 per cent., brick of a quality which will give a loss of 25 per cent. or even 28 per cent. may be used.

A recent canvass of modern brick paving specifications shows that 22 per cent. has been adopted as the maximum allowable abrasion in Grand Rapids, Mich., Fremont, O., Fostoria, O., Akron, O., Toledo, O., Newark, N. J., Philadelphia, Pa., Sidney, O., and Bryan, O.; 21 per cent. has been adopted by Chicago, Ill., Indianapolis, Ind., Canton, O., Columbus, O., and Sandusky, O.; 20 per cent. by Trenton, N. J.; and 20 to 22 per cent. by Baltimore, Md.

Pavements in Peoria, Illinois

By J. B. Jeffries, City Engineer.

During the year 1912, the city of Peoria laid more pavement than ever before in its history. One hundred and fifteen blocks, over ten miles, or one-eighth of the total extent of Peoria's paved streets.

The record in 1912 in street paving has been remarkable for three things; the practically universal adoption of the concrete foundation and cement grouting for brick paving, the rapid extension of the creosoted block paving, and the improvement of the residence streets of the city. The experience of the past years has taught the city improvement officials that the sand foundation and filling for brick paving is faulty. The street quickly turns from a smooth surface to a paving full of sink-holes and bumps. But the concrete foundation and the cement grouting, the former furnishing an absolutely level surface and the latter binding the bricks together in such a manner that the hardest rain is unable to undermine them, is a system that prevents all faults and gives a smooth surface that will last for many years.

On March 11, 1913, the city council authorized the laying of 15,000 more square yards of long leaf yellow pine creosoted wood block on Adams street. All of the creosoted wood block which we have laid thus far is southern long leaf yellow pine.

The first creosoted wood block pavement laid in this city was the improvement of South Adams street from Hamilton street to Bridge street, containing 11,500 square yards.

The street was torn up late in the fall of 1910 during the month of October; a 6-inch concrete foundation was used, a 1½-inch cushion of sand and a single layer of 3½-inch wood blocks. The size of the blocks was 3½x3¾x8 inches. They were laid diagonally across the street at an angle of 60 deg. with the center line. Longitudinal expansion joints of pitch were placed along the curbs and transversely across the street every 50 feet. The joints along the curb were 1 inch in thickness, while those across the street were ½ inch in thickness. The creosote oil used had a specific gravity of 1.10 at a temperature of 25 deg. centigrade and the blocks received a treatment of 20

ADAMS STREET, *Peoria, Ill., paved with yellow pine creosoted wood block.*

pounds to the cubic foot. Considerable criticism arose from the fact that, in the following spring and summer months, the street became a sea of tar. This was caused by the laying of the blocks in cold weather, and more pitch was left on the surface than was necessary, as it became hard before it could be spread over any great area. This objection has been entirely overcome, as the tar has rapidly disappeared, and the surface now presents a clean, dry appearance. This bleeding, to some extent, was caused by the blocks containing an excess of the creosote oil.

Liberty street from Adams to Madison streets, containing 3,400 square yards, was the next street paved with blocks. This pavement was started in the fall of 1911 and finished in the spring of 1912. The blocks were laid at right angles across the street and the expansion joints were placed as before. The specifications for the creosote oil were the same except that 18 pounds were used instead of twenty. This street has given entire satisfaction and no bleeding to any extent has been noticeable. In the summer of 1912, South Adams street was continued from Bridge to Oak street, a distance of 1,500 feet and containing 5,500 square yards, exclusive of the railway company; 3½-inch blocks were used with a treatment of 18 pounds of creosoted oil as before. The street railway company used a cement filler between the flanges of the rails, and this has prevented the buckling of the row of blocks adjacent to the rails. This strip of pavement is today the finest pavement in the city of Peoria.

This season South Adams street will be continued from Oak street to Cedar street, a distance of three-quarters of a mile, containing 10,300 square yards, exclusive of the railway company. Three and one-half-inch blocks will be used but the creosote oil specifications have been altered. The oil to be used will have a specific gravity of 1.08 to 1.10 at 38 deg. centigrade.

The blocks shall contain 16 pounds of this oil to the cubic foot and are to be laid at right angles across the street. Pitch expansion joints of 1 inch are to be used along the curb and ½ inch every 50 feet across the street.

The main objection to this class of pavement seems to be its slipperiness in damp weather, but this can be easily overcome by a light sprinkling of sharp sand. This slipperiness seems to decrease each year and I believe will finally disappear as the surface of the blocks becomes filled with

fine stones and sand. There is little or no wear to the surface of the blocks that have been down the past two seasons and the cost of maintenance is less than any class of pavement we have. They are rapidly becoming the ideal street for business property, as they are noiseless and sanitary, and property owners are becoming educated to the high qualities of this class of improvement and are demanding it in preference to any other kind.

Cleaning Streets in St. Louis, Mo.

James C. Travilla, Street Commissioner, City of St. Louis, Mo.

Many different methods of cleaning streets are in use in various cities thruout the United States, but few cities have been able to determine with any degree of accuracy the comparative efficiency of street cleaning departments. We have systematized the street cleaning department in St. Louis in such manner as to know the exact cost of all the work of the department and also to maintain a high degree of efficiency.

In St. Louis we use two types of street-cleaning machines, which are manufactured by the Sanitary Street Flushing Machine Company and the St. Louis Street Cleaning Company, respectively. We are also using a number of squeegee machines with excellent results.

With the "Sanitary" flushing machines we apply a spray of water thru an aperture about 5 inches wide in a down spout at an average pressure of about 40 pounds and at an angle of about 30 degrees. All asphalt, bitulithic, granite block and wood block pavements are cleaned in this manner.

One machine cleans about 14,500 square yards in 8 hours' work, using approximately, under average pressure, 2,500 gallons per 1,000 square yards.

The average cost per 1,000 square yards is about $1.21, about 1½ cubic yards of filth being removed.

The work is done by the city by day labor, flushing machines costing $7, teams $4 and laborers $1.50 per day of 8 hours, drivers being included in cost of teams and machines.

Water is furnished free by the city plant. At commercial meter rates it would cost 8 cents per 1,000 gallons, or 20 cents per 1,000 square yards, average.

The work done by the street cleaning force includes the following lengths and areas of streets, once a week in a residence district, or about once a month if an alley:

Streets Cleaned—	Miles.	Sq. Yds.
Asphalt	67.27	1,604,251
Bitulithic	45.43	1,097,022
Granite Block	71.83	1,670,148
Wood Block	9.36	201,904
Vitrified Brick	171.83	3,731,402
	365.72	8,304,727
Alleys Cleaned—		
Granite Block	8.89	85,325
Vitrified Brick	141.60	1,351,036
Granitoid	1.31	11,528
Limestone	57.33	471,177
	209.13	1,919,066

The appropriation for 1912-1913 has the following items:

$335,000	per annum for General Cleaning.
190,000	per annum for Patrol System "White Wings."
80,000	per annum for Municipal Stable (44 per cent. of appropriation for Garbage Removal).
$605,000	Total.

The city is divided into five cleaning districts in charge of district superintendents, who report to a general superintendent in charge of all the work. The district superintendents have supervision over inspectors in charge of men and machines. In the general superintendent's office is stationed a man familiar with the work, the city and the most convenient places for disposing of sweepings. The district superintendents and inspectors report by phone to him twice a day, and in addition, there are written reports received daily from the inspectors of the work done and the number of laborers, teams and machines employed. The unit of cost of the work is ascertained monthly.

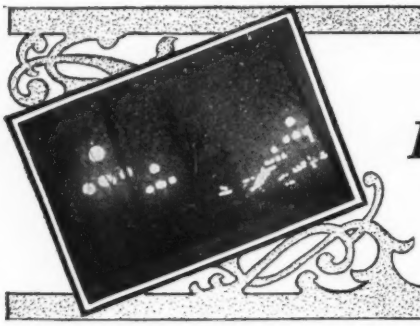
The average makeup of the various gangs and the cost are given in MUNICIPAL ENGINEERING, vol. xl, p. 32, the only change being a reduction of pay of inspectors, from $3 to $2.50 a day. A street-flushing gang of fourteen men and eight vehicles with their drivers, costs $67 a day and there are nine crews. A squeegee outfit with five men and five vehicles with their drivers costs $35.50 a day. There are two crews. A machine sweeping gang of fourteen men and nine vehicles with their drivers costs $62 a day. There are five crews. There are eight hand-sweeping and scraping crews each with thirteen men and two wagons with drivers, costing $28.50 a day. There are nineteen under an inspector, with a wagon for each six. Each patrolman covers from 2,000 to 11,000 square yards, the average being 6,000 square yards.

The unit cost figures given in the article referred to still hold good and are as follows:

Streets.

	Per 1,000 Sq. Yds.
Flushing	$1.00
Squeegees	0.45
Machine sweeping	0.81
Hand sweeping	1.58
Patrol system	0.25

No charge for water.



FIRE AND WATER

A Logical System of Meter Rates

By G. D. Crain, Louisville, Ky.

No system of rates which ignores the necessity for a fixed minimum income from every service can successfully withstand the test of commercial requirements without making the unit rate for water excessively high, thereby working a hardship on the large consumer. It is unquestionably practicable for a service charge to be so fixed as to give to the city an adequate revenue in a way independent of the water consumption, and at the same time to give the consumer some inducement to economy by charging him, in addition to the charge for "readiness to serve," only for the water which he actually uses.

A sliding scale of rates for water, giving the large consumer the advantage of a lower rate, which decreases with the amount of water used, is also objectionable, as operating unfairly to the individual consumer, and, in effect, making him carry the burden of the expense. Although from a strict commercial standpoint it is probably justifiable, on the ordinary theory that the purchaser in wholesale qualities is entitled to a reduced price, there is no apparent reason why a city should make any distinction of this sort, for, while, in fact, it costs precisely the same to be prepared to furnish water through a given sized meter to the consumer who uses but 200 gallons a day as to the one who uses 2,000 gallons, it does cost more to be prepared to furnish the quantity of water which would be normally consumed through a six-inch meter than through a ⅝-inch meter.

Logically, therefore, the difference in the kind of service required by the large and by the small consumer should be indicated by the service charge, and not by the rate; for, as a matter of justice, and certainly from the standpoint of the municipality, from which every citizen may reasonably demand the same treatment as every other citizen, the user of the minimum amount of water should not be compelled to pay any more per unit therefor than is paid by the great corporation, which consumes a relatively large percentage of the total amount daily conveyed through the mains.

Theodore A. Leisen, chief engineer and superintendent of the Louisville Water Company, a municipally-owned corporation, which supplies water for all purposes to the city of Louisville, Ky., at the rate of 25,000,000 to 30,000,000 gallons a day, from whom the opening sentence is quoted, says in the most emphatic manner that he is in favor of changing the company's present flat-rate system over to a straight meter system, with a graduated service charge based proportionately upon the size of the meter installed.

There are at present in use in the city about 3,000 meters, for the most part installed for the purpose of metering the water used by relatively large consumers, such as the railroads and other public corporations using the city service, numerous factories, and the like; and these concerns are charged a meter rate which is intended to give them some advantage by reason of their larger use of the water, while the ordinary dwelling is charged a flat annual rate based upon the number of rooms, size of lot, and number of water taps.

Sliding Scale for Readiness-to-Serve Charge

In a convincing argument, from the standpoint of the company of which he is superintendent, in favor of metering the service, Mr. Leisen presents some interesting figures. To start with, it is, of course, necessary to provide for a system of rating which will produce a revenue sufficient for the operation of the plant, as well as for all necessary extensions and improvements, including for Louisville's plant fixed and overhead operating expenses of $190,000, production expenses, including pumpage, filtration, etc., of $110,000, and construction expenses of $200,000 more, a total of $500,000.

Inasmuch as the overhead expense item

of $190,000, which includes the expense of the administrative and revenue departments, general expenses, interest, and a 50 per cent apportionment of distribution and general operating expense, exists independently of the quantity of water sold, it logically follows that this sum should be met by a fixed income; and this, Mr. Leisen proposes should be done by a service charge on each meter installed. Taking the 32,000 services in actual use in the city, and dividing the overhead expense by this number, $5.94 is produced as the average sum which must be charged in order to take care of the fixed overhead charges.

Under the plan proposed, however, this charge would not be the same for all classes of consumers. Starting with a $6.00 charge for each ⅝-inch meter, it is suggested that the charge be $9.00 for each ¾-inch meter; $12.00 for 1-inch, $24.00 for 2-inch, and on up to $72.00 for a 6-inch meter. On this basis it would be an easy matter to produce by this service charge a sufficient revenue to meet all fixed overhead charges, and leave a safe margin in addition.

"The object in increasing the service charge in proportion to the size of the meter is twofold," says Mr. Leisen in a report on the subject. "It makes more equitable distribution of the charge, proportioning it to the service rendered; and it deters consumers from applying for a larger meter than is actually required. This "service charge" would not cover the cost of any water consumed, but would take the place of a meter rental, and serve the equivalent purpose of a 'minimum charge.' It covers the value of what is generally designated as a 'readiness to serve' charge, and being based on the proportionate amount of fixed overhead charges, is figured on logical reasoning, and is not a mere arbitrary or haphazard charge.

Uniform Meter Rate

"With this 'service charge' established as outlined herein, the water can be furnished to every consumer at exactly the same rate, regardless of whether he uses one thousand gallons or one million gallons, and this rate can be fixed at four cents net per thousand gallons and within a few years it could probably be reduced, in which event we might claim, without fear of contradiction, that we were furnishing the cheapest water of any city in the country having similar conditions to contend with."

The system suggested, coming from an engineer who is conceded to be an authority in his field, is interesting, to say the least; and while the uniform rate proposition may meet with some criticism from those quarters where the idea is still held that the large consumer is entitled to special consideration, simply because he is large, the general question of the fairness of metering the service as against making a more or less arbitrary flat charge can hardly be seriously questioned. Even a sliding scale of rates, giving the large consumer a lower rate, is much preferable to the unscientific flat rate as long as the charge per thousand gallons to the ordinary citizen is not made unreasonably high. It would seem, however, that a graduated service charge, along the lines laid down by by Mr. Leisen, would solve the question satisfactorily, as well as logically, in most cases.

Drilling the Firemen

A practice tower has been erected in the yard of one of the fire stations in Los Angeles for the purpose of drilling the men and making them expert in their line of work.

All the up-to-date fire apparatus for the saving of life and property is in use. The tower is of wood, 75 feet high and 12 feet square. Windows are placed on all sides of the tower to make it as much like a real building as possible.

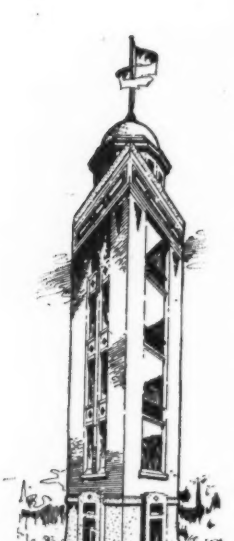
The fire captain directs this drill from the ground, sending four men at a time up the ladder. Each movement is timed in order to prevent confusion. Life lines as well as ladders are used in ascending and descending.

LIFE-SAVING NET *at base of practice tower for Los Angeles firemen.*

Every phase of the fireman's work that he may ever be called upon to do in case of fire is practiced, such as leaping from the different stories into the life nets and rescuing dummy figures, carrying them down the fire escape to the ground.

In this way the untrained men who enter the service soon become skilled in the work.

Two cuts show the practice tower in use and the life net ready for practice.



PRACTICE TOWER
for firemen of Memphis, Tenn.

Memphis, Tenn., is constructing a practice or steel training tower, to cost $3,000, for the use of the fire department. The tower will be square, constructed to represent a building of some three or four stories. There will be apertures of the size and shape of doors and windows, and a spiral stairway will lead to all parts of the tower on the inside. The accompanying sketch shows the design of the tower.

The installation of the practice tower will be but another step forward toward making the local department the most efficient in the country. Commissioner Utley is constantly formulating and carrying out plans for the betterment of the department and the results are reflected in a decrease in the ratio of fire loss in Memphis.

It is expected that the training or practice tower will prove of inestimable value to the department, especially in the training of new and inexperienced members. Ladder climbing, hose raising, wall scaling, life saving and other duties which a fire fighter is called upon to face will be practiced daily.

"It is my ambition to bring the Memphis department to a point of efficiency second to none in the United States," said Commissioner Utley, in discussing plans for the future, "and I am sure that the inauguration of a daily practice will do much in that direction. Practice towers are now in service in a number of progressive cities and wherever they have been tried increased efficiency has been the result."

PRACTICE TOWER
for firemen of Los Angeles, Cal.

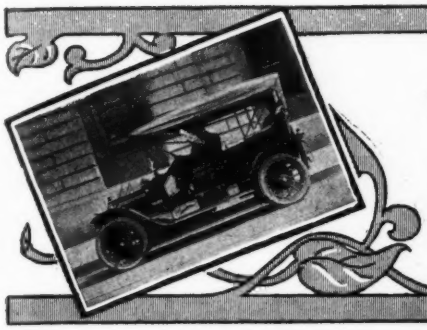
American Water Works Association

The thirty-third annual convention will be held at West Hotel, Minneapolis, Minn., June 23-27, 1913.

The following papers are scheduled: "The Diesel Engine for Water Works," by Edward S. Cole; "Water Works Special Franchises," by Henry DeForest Baldwin; "Reforestation and General Care of Water Sheds," by Ermon M. Peck; "The Bacterial Count on Gelatin and Agar Media and its Value in Controlling the Operation of Water Purification Plants," by James M. Caird; "The Tuscaloosa, Alabama, Water Works," by Prof. Edgar B. Kay: a paper on filtration, by George W. Fuller; "Charges for Public Water Service to Private Fire Protection Systems," by W. E. Miller; "A Reasonable Basis for the Determination of Charges for Private Fire Protection," by Leonard Metcalf; "Metering Private Fire Services at Kenosha, Wisconsin," by August Baltzer; "How a Private Fire Service Polluted a Public Water Supply and Some of the Consequences," by Robert J. Thomas; "Modern Filter Practice," by Nicholas S. Hill, Jr.; "Gravity Water Supply at the City of Manila, Philippine Islands," by H. E. Keeler; "Power for Pumping Derived from Refuse," by E. H. Foster; "Pumping Engines," by L. E. Strothman; "Ground Water Supplies," by Charles B. Burdick; "Rates and Rate Making," by Halford Ericson.

On Tuesday and Thursday evenings illustrated lectures will be delivered by Edward Wegman and Dr. William P. Mason.

There will be excursions on Wednesday and Friday afternoons.



Automobiles in Municipal Service

The Motor Truck in the Gas Business

One of the most interesting discussions at the recent meeting of the Indiana Gas Association was on the subject of the motor truck in the distribution department. The discussion was opened by G. M. Dolley, of Logansport, who considered the conditions in a small gas plant. He does not use one because he finds that where one horse and wagon is required for the work of the department the motor truck is not economical. He thinks that the motor truck, with proper management, should do the work of two or three horses and wagons.

One essential of economical operation is a driver who can give the machine proper care and keep it in repair without the necessity of taking it to a repair garage, and gives some instructions for keeping the truck in good running order, and for spending the time when he is waiting in looking after his machine.

Overloading a truck seriously affects the economy and safety of its operation. Excessive pressure on bearings and on tires, lubrication troubles, insufficiency of brakes because of the greater inertia of the heavy load, for which the brakes were not designed, greater heating effect, are some of the reasons for prohibiting overloading which are suggested.

The driver should have some knowledge of piping and tools used so that he can often handle supplies when otherwise it would be necessary to take along one of the fitters. The truck driver can then take care of pipefitters on several jobs at the same time, keeping them supplied with materials and transferring them from one job to another. He can even serve as inspector of the work done by the fitters if competent.

As to cost of operation Mr. Dolley reported that only eight motor trucks are in use in Indiana by gas companies and only five of these could give figures of cost, only two of these being in detail.

For six months included in the reports received, the cost per mile was 2.9 cents in one case, 3.5, 9.6, 10.3 and 12.8 cents in the others. This does not include tire cost, and in but two cases are the figures given in detail. In both these cases 1-ton trucks are used. The mileage per gallon of gasoline was 9 for one and 7.8 for the other.

Fuller data are given for eleven trucks used by gas companies outside the state. In these cases the cost per mile where tire cost is not included is from 3.6 to 5 cents per mile run. Where tire cost is reported the cost of operation, including tire cost, is 1.8 to 7.4 cents a mile. In the latter case the tire expense was $116.20 for 4,246 miles run, and in the former it was $34.94 for 3,258 miles run.

The mileage per gallon of gasoline varied from 5.4 miles for a 2-cylinder, 10-h.p. car to 19.5 for a 4-cylinder, 20-h.p. car. There seems to be no relation between cost per mile, miles per gallon of gasoline, horsepower, number of cylinders or miles run. Total expense of operation bears some relation to mileage but this statement has several exceptions.

Mr. Graf, of the Indianapolis Gas Co., finds it best to send two men with each truck, who are pipe fitters as well as drivers, finding that one truck will not serve several parties satisfactorily. He finds that one truck will do from one and one-half to two times as much as a one-horse wagon. The greater ground covered is worth the difference in cost, however. A truck covers an average of 30 miles a day, in less than half the time it would take a horse, thus saving $3 to $5 a day in time of men sitting in the wagon, which must be considered in figuring the difference in cost. Mr. Graf calls attention to the fact that depreciation, interest and insurance are the most important items in the cost of motor trucks and they are not included in Mr. Dolley's figures. He assumes 25 per cent. a year depreciation, or $400 a year on a $1,600 car, and finds that liability and fire insurance cost nearly $100 a year per car, so that the total cost of operating a truck will be much more than that given in

the figures above, and will not be less than 15 to 20 cents a mile run. But even then the saving of time of men, additional work done, facility of attending to calls warrant the use of the motor.

Mr. McCleary called attention to the value of the motor truck to a company which operates in several towns, in saving of time over wagons or over interurbans when cars must be waited for or over street cars run in connection with them. He uses a truck to distribute the men to the jobs in his five towns within a radius of five miles; a meter truck, which displaced two wagons and does the work of four; and a store-room truck for making short, light deliveries. He estimates, without having the figures, that he saves from $100 to $200 a month with trucks over equivalent horse service.

Geo. D. Smith quoted the figures obtained by the Massachusetts Institute of Technology on cost of operating cars and wagons: A 1,000-pound-capacity car cost $7.75 a day for 40 miles possible travel of an electric car; $9.23 a day for 80 miles of a gasoline car, and $5.90 a day for 30 miles of a two-horse wagon. The actual average mileage covered was 35 for the electric, 38 for the gasoline and 25 for the horse, including in the average the days when cars or wagons are laid up for repairs.

The Institute's figures for cost of running an electric truck 10,000 miles in a year were given as $2,152, allowing 10 per cent. interest on $2,200 cost of a car of 1,000 pounds capacitv, current $160, garage $200, driver $710, used for 285 days, all of which figures seem to be above the usual averages.

Denver Motorcycle Squad

By Felix O'Neill, Chief of Police, Denver, Colorado

The Denver police motor squad, numbering eight, is stationed at fire houses in the outlying districts, and is subject to call at all hours, day and night. There are two men at each fire house, one on duty all the time.

The motor officers receive their calls at the fire houses, and are not supposed to leave during their hours on duty, except on hold-up or burglary calls.

We have two motorcycle officers who work on violation of the speed ordinance and stolen machines alone. We also have an emergency motorcycle officer, stationed at headquarters, who replies to nothing but emergency calls.

Cost of Operating Motor Trucks

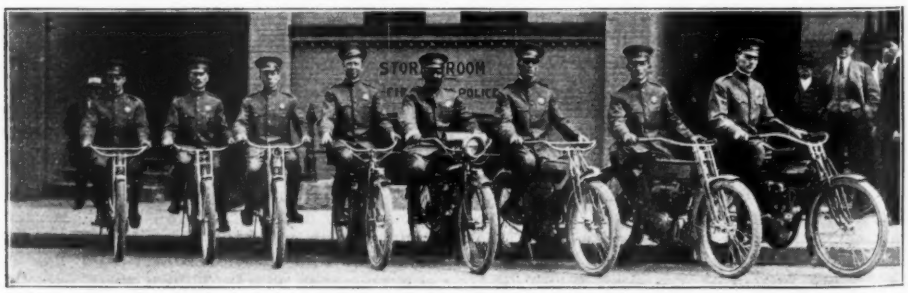
In the May number of *Power Wagon*, published in Chicago, will appear an article by R. W. Hutchinson, Jr., on "The Motor Truck in Engineering and Contracting Industries," from advance copy of which the following data are taken concerning the actual cost of operating motor trucks, the resulting unit costs having been computed from the data given in the paper.

Labor Cost.

The Keystone State Construction Company hauls 4½ tons of coal on each of two Mack trucks from the railroad to the Hill View reservoir site at Yonkers, a round trip of 5 miles, returning empty, 8 hours a day, 300 days a year, 6 loads a day. Coal is shoveled from car to truck and from truck to shed. The driver is paid $3.50 a day and three helpers at $1.60 each travel back and forth on each truck to load and unload. The total labor cost is therefore $8.30 for 27 tons a day and 30 miles of travel.

The labor cost per ton of coal delivered is the total labor cost per day divided by 27 tons or 30.74 cents. It is hauled 2⅛ miles, so that the cost per ton-mile is 12.3 cents.

A Saurer 6½-ton dump truck is in the same service, averaging 7 tons per load and has a driver at $3.50 and 4 men at $1.60, three of whom remain at the coal cars and help load the Mack trucks. Charging all the time of the 4 helpers to the Saurer truck it costs $9.90 a day for 6 loads or 42 tons and 30 miles travel per day.



THE MOTORCYCLE SQUAD, *Department of Police, Peoria, Ill.*

The labor cost per ton of coal delivered is 23.57 cents and per mile the coal is hauled is 9.43 cents.

The consumption of gasoline for two Mack trucks and one Saurer truck is 12 to 15 gallons a day.

Total Cost Per Ton Mile.

Henry Hanlein & Sons operated a 6½-ton Saurer truck 5,728 miles in 200 working days, an average of 28.6 miles a day, loaded to capacity one way and empty the other. The investment was $6,250.

Interest at 6 per cent., depreciation on $5,842, not including tires, at 10 per cent., insurance of all kinds at 5 per cent, and driver at $936, made the

Fixed charges	$2,185.20
Maintenance and repairs	59.38
Gasoline	236.43
Tires at 5.1c per mile	292.13
Oil	85.70
Total cost per year	$2,858.89
Total cost per day	14.2'

Total cost per ton-mile, 6½ tons, 14.3 miles (one way), 15.3 cents.

Comparison With Team Cost

Hook & Ford ran a week's test, hauling stone from their Dickeyville quarry for road building. The team made 9 miles on a round trip and the truck 10 miles on account of a weak bridge on the shorter route. One mile of the trip loaded was up a 14 per cent. grade. Average consumption of gasoline was 21 gallons, of oil 2 gallons; average hours of work 10; average loading time 3 minutes; unloading time 10 minutes; spreading stone over the road 1 minute; number of trips 6; total mileage 60; total loads 60,000 pounds; all per day. Three rainy days kept the roads soft and in bad condition for the truck. From the data Mr. Hutchinson prepared the following:

MULE TEAM.

Investment:	
4 mules at $325	$1,300.00
Harness	75.00
Wagon	250.00
Total	$1,625.00
Fixed Charges:	
Interest on one-half investment at 6 per cent	48.75
Insurance on team	32.50
Depreciation, 20 per cent	325.00
Total, per year	$ 406.25
Per day (225 working days)	1.85
Daily Operating Cost:	
Wages	$ 1.84
Feeding at 60c	2.40
Stable man	.25
Doctor	.20
Shoeing	.30
Repairs	.20
Feeding 140 days idle time per year on account of cold weather, $224, or	.99
Total	$ 6.18
Adding fixed charges	$ 8.03

The team hauled 13½ tons an average of 4½ miles of 57.37 ton-miles per day, costing, therefore, 13.9 cents per ton mile.

MOTOR TRUCK.

Investment	$5,300.00
Fixed Charges:	
Interest on one-half investment at 6 per cent	159.00
Insurance, 2½ per cent. on 80 per cent. of one-half value	53.00
Depreciation, 10 per cent, not including tires	480.00
Total	$ 692.00
Per day (225 working days)	3.07
Daily Operating Cost:	
Wages	$ 2.50
Maintenance, 4½c a mile	2.70
Tires, 6c a mile	3.60
Gasoline, 4c a mile	2.40
Oil	.60
Total	$ 11.80
Adding fixed charges	$ 14.87

The 5-ton truck hauled 30 tons an average of 5 miles or 150 ton-miles per day, costing, therefore, 9.9 cents per ton-mile.

This shows an average saving on the basis of a year's work, of 4 cents per ton-mile or $6 a day or $1,350 a year.

The P. McGowan Contracting Co., of New York, operate two 7.5-ton Mack dump trucks on which they have kept records from which the following averages have been taken:

Working days, number	140
Miles per day	46
Total mileage	6,427
Approximate No. of trips	2,994
Av. miles length of haul	1.07
Total fixed charges	$1,284.88
Total operating cost	1,453.94
Total cost	$2,738.82
Miles per gal. of gasoline	3.25
Miles per gal. of oil	21.30
Av. load, tons	6.
Av. ton-miles, per day	137.37
Av. No. of loads per day	21.4
Av. cost per day	$ 19.56
Av. cost per mile, cents	43
Av. cost per ton, cents	15.50
Av. cost per ton-mile, cents	14.15

It is difficult in most cases to keep exact records of tonnage carried and mileage traveled in such way that the actual cost per ton-mile can be obtained, and there is, therefore, a tendency to assume the capacity of the truck as the

tonnage carried. This may be somewhere near correct on account of a tendency to overload trucks on occasion, but it is not accurate. Mr. Hutchinson's paper gives a number of other figures of cost which are not so definite nor so detailed as those given above, but which are of value for consideration of similar conditions. The constant demand for exact figures is being met more fully as the experience with trucks is greater, but the new uses for trucks are extending so fast that it will be some time before the figures of cost obtainable are so extensive as to answer all questions.

Trackless Trolley Lines in Austria

By Frank C. Perkins

THERE is a passenger and postal electric trackless trolley service running between the railway station and the town of Gmuend in Lower Austria, which is under municipal control. The trackless omnibus operates from 5 a. m. until 10 p. m., making from thirty to fifty trips per day, and this single car has carried about 45,000 passengers and over 1,000 packages, covering a distance of 15,959 kilometers (9,917 miles) without a single repair.

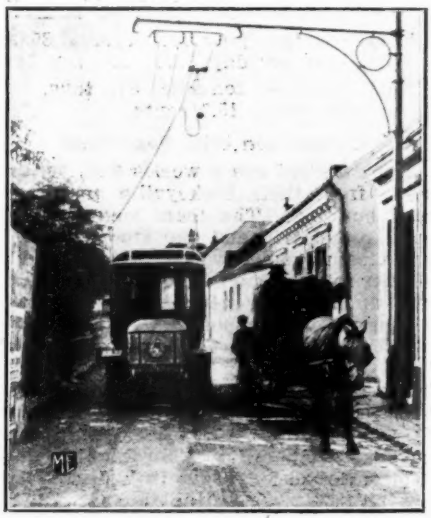
It is stated that, including the lighting of the car and the garage and operating the omnibus, the total consumption of current for the 16,000 kilometers (nearly 1,000 miles) travel was 3,030 kilowatt-hours. This is about 190 watt-hours per car per kilometer, 306 watt-hours per car mile, or 65 watts per kilometer-ton, 103 watts per ton-mile, on an average.

The trackless trolley line at Gmuend has gradients of 1 to 2 per cent., being slightly hilly the entire length, with a maximum grade of 4 per cent. for a distance of about 4 meters (13 feet). The cost of operation is exceedingly low on this line, all of the expenses, including current, for six months, being less than $600.00 per car. The cost of maintenance is said to have been $90.00 oil, grease $85.00, and current $190.00. The receipts of the line amounted to somewhat over 6,000 francs ($1,200.00) or double the cost of operation for that period.

How It Works

The equipment and method of operation of the new Mercedes-Stoll electric trackless trolley traction equipment is seen in the accompanying photographs. The current is taken from the overhead positive wire and returned to the negative wire by means of flexible cables and not by a trolley pole, an over-running shoe being used instead of an under-running wheel. The current collector or head consists of a frame having two small, grooved wheels on each side of it, the positive wire supporting one of these pairs of wheels while the other pair runs on a negative wire, from which point there is also a weighted pendulum suspended for keeping the wheels down in contact with the trolley wires.

The trolley runs with little or no sparking, the wheels running on ball bearings and the pull of the cable acting upon a very short lever arm. The center of gravity of the trolley is very low, so that there is no deviation of the trolley, in spite of strong transversal pull, the conducting cable being lengthened so as to follow the car by two devices. There is an upper sliding knot tied up on the pendulum weight, as shown in the illustration, and stretched by means of a spring from the latter. There is also provided a cable roller with 30 or 40 feet of cable, which is let out or rolled up by means of a spiral spring.



VIENNA MUNICIPAL TRAMWAYS.
Trackless trolley bus passing vehicle on the Potzleinsdorf-Salmannsdorf line.

These two appliances allow the car to run on the whole width of the roadway, to turn out in overtaking or meeting automobiles or other vehicles and accommodate itself to every form of traffic. When two trackless trolley cars meet, the motormen simply interchange the trolley cables by detachable contact boxes, this being a decided advantage over a single track electric railway on which much time is lost in waiting at passing points.

In the chassis of the vehicles, pressed steel is used, weighing about 1,700 kilo-

grams (3,748 pounds). The brakes act on the back wheels and there are two motors provided, which form a part of the driving wheels themselves. The motors are of 20 horse-power each and are mounted on the driving wheels of the Lohner-Poreche system, so that there are no mechanical parts required for control or transmission with their accompanying losses.

Very little lubrication is required, as all parts of the motor and wheels run on ball-bearings. The cable transmits the current, which passed thru the axle and the armature of the motor is fixed on the axle itself by means of keys. The remainder of the wheel is mounted on ball-bearings as an ordinary motor and entirely enclosed and protected from dust, the cover hermetically sealing the motor as well as serving to fasten it on the axle.

Cost of Operation

In Vienna, the cost of running the trackless cars 75 miles each daily is from 7 to 9 cents per mile, the line having a length of 2.2 kilometers (nearly 5 miles). The current cost for the 75 miles is from 40 to 60 cents, at 1 cent per kilowatt-hour. The tours with total load of 4.2 tons cost $1.50 to $2.00 wages, $1.50 for driver only, with taxes, repairs and garage, bringing the total running cost to from $5.20 to $6.30. The Vienna line passes thru narrow streets and around sharp corners and on grades of 10 per cent. for a long distance. The negative pole is connected to the Vienna city electric tracks and the positive pole of the trackless trolley to the city conduit conductors.

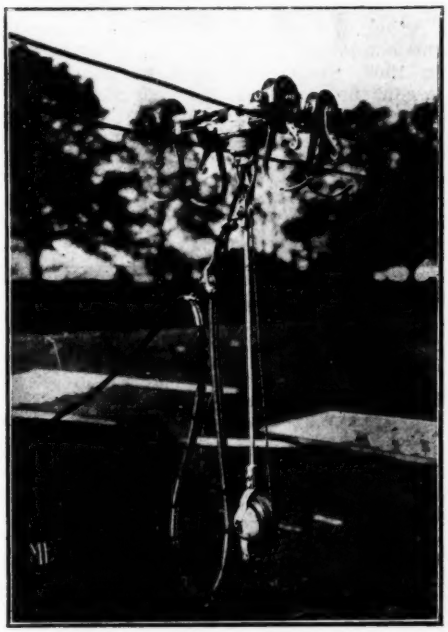
Advantages Over Other Systems

This system possesses many advantages, both financial and mechanical, over electric storage battery cars, as well as gasoline or oil motor omnibuses. At Vienna the new Mercedes-Stoll trackless trolley is operated in connection with the municipal tramway and has just been started. The Pressburg line in Hungary has a total length of 5.8 kilometers (3.6 miles). It has four conductors, one freight wagon and six trackless trolley omnibuses. The total cost of the line is reported to be about one-third million crowns ($67,000).

The trackless trolley system, in operation at the places mentioned and others, is the invention of Herr Ludwig Stoll of Vienna. Among the strong claims made for the system are its simple, rapid, silent and smooth running, as well as its freedom from breakdowns and interruptions of service. Its great economy of operation and lightness of the omnibuses used are largely due to the motors, which form part of the road wheels of the cars.

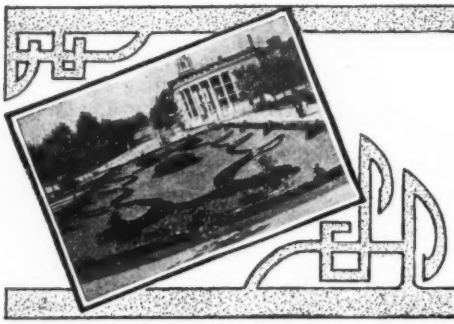
At Weidling, not far from Vienna, the Stoll electric trackless trolley road is 2.3 miles long, having a steep gradient of 7 per cent. There are five trackless trolley cars or omnibuses in service, each carrying 21 passengers. About 100 miles are run daily from 5 o'clock in the morning until midnight. With three cars running, 2,700 passengers are carried without difficulty on Sundays. Non-stop runs are possible, only 10 seconds being required for interchanging the trolley cables at the meeting of the cars, this being done at any point on the line.

On these omnibuses solid tires are used and electric brakes, as well as mechanical brakes, are provided with pedal and hand control. The two 20-horse-power motors



CURRENT COLLECTOR *for Electric Trackless Trolley.*

on these trackless trolley omnibuses may be overloaded to double their output in emergencies without getting dangerously hot. The cars weigh 2.5 tons each and carry 22 passengers, this small weight compared with the load carried being of great importance in relation to road surface wear, rubber tire wear and consumption of current.

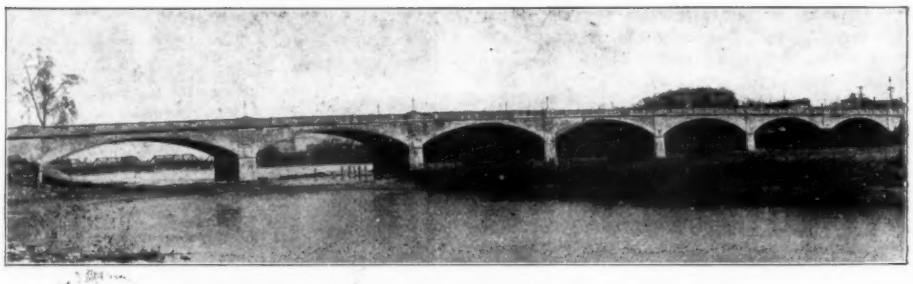


CIVIC BEAUTY

What Cedar Rapids Has Done in Five Years Under Commission Plan of Government

By Hon. Louis Roth, Mayor.

When the city of Cedar Rapids adopted the commission plan of city government, in 1908, there was constant friction between the east and the west sides of the city, which is bisected by the Cedar river. In the middle of the river and in the heart of the city was a low-lying island, some five acres in extent, upon which stood a few frame cottages and two or three business buildings. One section of



SIXTEENTH AVENUE BRIDGE, *Cedar Rapids, Iowa.*

a steel bridge connected this island with the west side and a similar section made the connection with the east side. A steel bridge at First avenue, just above the island, carried the street railway and general traffic. There was another old steel bridge at Sixteenth avenue, but a new concrete bridge had just been completed at Second avenue connecting the east and west sides of the city with the northerly point of the island. This bridge cost $84,000.00, exclusive of the pavement and sidewalks.

The city at that time was doing its municipal business in an old ruin of a building which was built in the fifties for a hotel. The original building was of rubble and plaster, but frame additions had been made. The building was disreputable, but it stood on a good business corner at Third avenue and Second street.

One of the first acts of the first council under the commission plan of government was to send for Charles Mulford Robinson to prepare a plan for the harmonious development of the city along artistic lines. His chief recommendation was that the city acquire the island and establish there the civic center. The city council at once set itself to this task. The old city hall corner was sold for $63,000 and the island purchased for $125,000, the owners of the lots on the island taking mortgages for part of the payment. A big three-story brick building which has been used for a few years as a furniture store was remodeled for use as a temporary city hall at a cost of $20,000. A laundry building was remodeled for use as the police station and city jail at a cost of $6,500. A big barn to house all the city teams and machinery was constructed on the south end of the island between Fourth and Fifth avenues, at a cost of $8,000.

In the meantime, the city proceeded to fill the low-lying portions of the island and bring the whole to the general street grade. Cedar Rapids is a rapidly growing city and excavations are constantly being made for big office buildings in the business district close to the island. Contractors have been glad to use the island as a dumping place for the dirt excavated, at a very low cost to the city.

That portion of the island between Second and Third avenues has been brought to grade and now serves as a public park with trees, grass and flower-beds. Next year, that portion of the island between Third and Fourth avenues is to be similarly treated.

Below Fourth avenue, on the west shore of the island, a bathing beach has been established and a small bathhouse was built in 1912, at a cost of about $1,000, for the benefit of the boys and girls. This proved exceedingly popular and the commission is now planning for the erection of a much larger bathhouse this year.

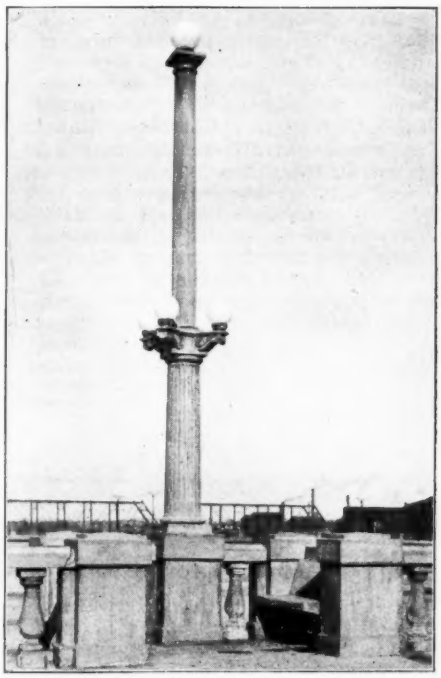
In 1911, the city council let a contract for the erection of a big concrete bridge at Third avenue and the removal of the old steel bridge to Eighth avenue. Both bridges are now practically completed, the steel bridge having been refitted and rebuilt at Eighth avenue at a cost of $25,000 while the total cost of the bridge at Third avenue, with the pavement, will be $160,000. This bridge has a total width of 68 feet, with two 10-foot sidewalks and a roadway of 48 feet. It was designed to carry the heaviest type of interurban cars and the probability is that a double street railway and interurban track will be laid across it this year.

While this bridge has been building, the city, with its own equipment and day labor has been building reinforced retaining walls and sidewalks along the banks of the island. These are completed from Second avenue to Third avenue and work is progressing on that portion of the island between Third and Fourth avenues, all the foundations having been put in during the last summer and fall. Next year this portion of the work will be completed, together with the filling and parking of this part of the island. It is here that the new city hall is to be built by and by, and the hope is that it will be a combined city and county building, one of the biggest and most ornate structures in the state.

Plans for the future also include the building of the island to a point above First avenue. A majestic soldiers' monument to be paid for by popular subscription will stand at the extreme head of the island. The present steel bridge at First avenue, which carries a double street railway track will be removed to make way for a concrete bridge similar to that just being completed at Third avenue.

Retaining walls are to be built along both sides of the river thru the business district and an 8-foot concrete dam is to be built at Sixteenth avenue so as to provide deep water suitable for boating in the summer and skating thru the winter thru the city from north to south.

The first city council under the commission plan, beginning in 1908, erected a handsome concrete bridge across the river at Sixteenth avenue, in the south end of the city. This bridge cost, complete, $75,000.00, and has been of immense value not only to business but also in uniting the two sides of the river into one.



A RETREAT *on Third Avenue Bridge, Cedar Rapids, Iowa.*

When the commission plan was adopted, the city had no permanent fire stations. Two handsome buildings of brick and cut stone have been erected at a cost of $7,000.00 each and another is now under construction, which will cost $10,000 when completed. This is to be provided with motor-driven fire fighting apparatus which will be this city's first venture in that direction.

Under the old form of government the three park commissioners had done splendid pioneer work in park development. This duty now falls upon one member of the commission, who is the superintendent of the Department of Parks and Public Property. The park development so well begun by the old park board has been well carried on by the park commissioner and the city now has 207 acres of parks properly landscaped and adequately furnished and cared for. The playground idea has been made prominent and much modern apparatus installed. Sunday afternoon band concerts are another popular feature.

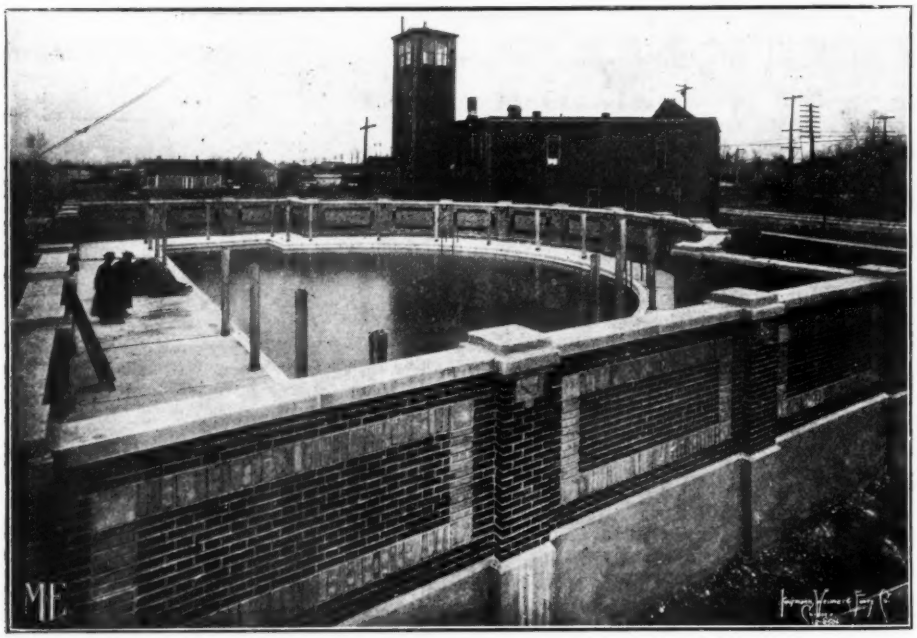
Meantime, the city has been rapidly growing and the usual public improve-

ments have proceeded at a rate which was not possible under the old form of government. There have been large extensions in street paving. Every street and avenue throughout the city has its permanent sidewalks. Boulevard lights on handsome electroliers have been installed on the business streets. Storm water and sanitary sewers have been extended to the outskirts of the city. Miles of mains have been laid by the water commissioners, the city owning its own water plant. Large residential park additions have been landscaped by experts like Simonds, of Chicago. These additions have been paved, sewered, water mains, gas mains and electric light lines installed and ornamental trees and shrubs planted. Most of this has been made possible by the harmonious feeling that resulted from the establishment of the civic center on the island; and the fact that the commission plan of government, unlike the old ward system, studies and works for the development of the city as a whole. This year, the Cedar Rapids and Marion City Railway Company will spend $25,000 in the development of its property. The Iowa Railway and Light Company is building an electric line to Mt. Vernon, sixteen miles away.

All the improvements mentioned above have been secured without raising the tax levy. In fact, it is nearly two mills lower now than when the commission plan was adopted. The mortgages given on the island have been taken up, the bridge bonds are rapidly being retired and the credit of the city is gilt-ed,;ed. The record of the five years of commission plan of government in Cedar Rapids is one of continued progress towards definite ideals; a thoroughly modern, progressive, harmonious city.

The city owns its water works. The city took over the plant about eight years ago at an appraisement price of $473,000.00. Its net earnings since that time have been a little more than $190,000.00. The net earnings for each quarter average above $10,000.00, and the present valuation of the plant is $745,845.00. The plant is governed by three water works trustees under the direction of the city council. Their salaries are $300.00 per year, each.

We are now contemplating additional improvements; also the reduction of the minimum charge of water to 60c for the first 500 cubic feet. The whole venture has proven an unqualified success from the standpoint of the taxpayer as well as the city.



NATATORIUM *in open air for Chicago children. Fire department station in rear. Pumping station of water department on same property.*

First Open Air Natatorium for Chicago

The first municipally owned "swimming hole' 'in Chicago is to be opened for Washington Heights and Tracy when the bathing season starts. It is an up-to-date natatorium, with diving paraphernalia, hot and cold shower baths, dressing-rooms and lockers. It has a capacity of 124,000 gallons, and will be filled with fresh water every day. The work, which is almost completed, has been done entirely by the city and paid for by an appropriation of $10,000 made by the council.

The swimming basin will be 50 by 90 feet, one of the largest in the city. It will have a fresh-air advantage over many others by being uninclosed, the swimmer being able to accumulate as much sunburn and tan as if he trudged the five miles to the lake.

For beginners, one edge of the basin will have only 3 feet of water, but a depth of 8 feet will be maintained at the other end. Four dressing-rooms, 160 lockers, bath towels, brushes and combs will make up the side line incidentals. An attendant will look after the property, and provide each swimmer with a two-piece suit to comply with the city ordinance.

The construction of the natatorium has been under the direction of Charles W. Kallal, city architect. Twenty-nine clusters of electric lights are to be installed, when it will be ready to turn over to the park commission.

Presence of Firemen Means Safety

City property at One Hundred and Third street and Vincennes road, now partly used by the pumping station on one side and a fire engine-house on the other, was chosen as the site of the natatorium. The fire station is not more than fifteen feet from the water's edge, which makes the parents of the children feel safe about them.

"A municipal natatorium is the only thing," said Commissioner of Public Works McGann. "The city ought to have more of them, scattered in spots far from the lake. I believe every pumping station which the city constructs from this time forward should have a natatorium for the public as part of it. I have given orders that no plans for new pumping stations be drawn during my administration without a natatorium adjoined. When the city has the property and the water, and the people want it, give it to them."

The walls are entirely above ground, are waterproofed with McCormick Shamrock brand waterproof compound and show no signs of water seepage or leaks.

East San Diego's Open Air City Hall

East San Diego is a thriving California municipality of the sixth class, incorporated November 2, 1912, with a population of 4,000, which is still growing at a rate faster than the 2,000 a year which that population represented.

Harvey M. Holleman is a young man with financial training in New York, sent to Texas to carry out some important

HARVEY HOLLEMAN, *Mayor of East San Diego, California.*

work for the Southern Pacific railroad, and passing thence to Denver, where he was a president, vice president of treasurer of several financial institutions, including bank, insurance, bond and loan companies. After three successful years there he moved to San Diego two years ago. He built a bungalow on City Heights, which was a little community of 200 population on the table land east of San Diego and 420 feet above the sea. His energy was evidently communicated to the place, for it has become the present city of East San Diego within that time. Very naturally Mr. Holleman is the first mayor of the new city, an honorary office, for no city officers draw salaries except the city attorney and the city clerk $300 a year, and the city treasurer $120 a year.

The new city has already street cars, telephones, water, electric lights, a $75,000 school house with adequate playgrounds, no saloons, and is occupying a unique city hall.

An observation tower was built some years ago to give views of the wonderful scenery in every direction and when the

OPEN AIR *City Hall, East San Diego, California.*

city grew the lot on which it was located was sold. To get rid of it the tower was sold at auction for 35 cents, sold again for $25, moved across the street and improved and now its five floors rent for $1,600 a year. The first three floors are business rooms, the fourth is fitted up for the city hall and the fifth is the city's council chamber. It is open to the air on all sides, as the photograph shows, and a special meeting of the board of trustees was held on Christmas day, 1912, with straw hats and shirt sleeves to demonstrate the beauties of the San Diego climate. The thermometer registered 71, nine degrees higher than at the beach, four miles away. The owner of the tower, C. O. Stensrud, has donated one year's rent of the council chamber to the city. The fifteen city officials hail from fourteen different states.

Well Regulated Playgrounds

By C. F. Booth, Supervisor of Playgrounds, Minneapolis, Minn.

The importance of properly equipped and well regulated playgrounds cannot be overestimated. In Minneapolis we are making every effort to beautify and improve our playgrounds which are accomplishing splendid work with the children.

Trees are planted on the various grounds by the school children on Arbor Day in locations suggested by the superintendent of parks and the supervisor of playgrounds.

Waste barrels are provided by the city engineer's department, making it possible to keep the grounds much tidier, for every small boy and girl has candy and school papers or fruit skins, so these waste barrels fill a long-felt want.

Bubble drinking fountains are installed in all the shelter houses in addition to those provided on some of the grounds out of doors, and they are highly appreciated by the children.

The committee began during 1911 the collection of a library of playground information for its own use and that of the playground directors especially, but to be accessible to any interested in the subject. It is now housed in the chairman's office in a case provided out of funds donated by the original civic playground committee. It includes most of the publications to date of the National Recreation and Playground Association of America, files of the *Playground Magazine*, reports on playgrounds commissions in other cities, pamphlets on physical education and civic recreation work, and a few books on games, folk dancing, story telling and education by play. During July and August, many of our playgrounds are kept open several evenings a week. The play-directors remain on duty during these hours. The grounds are always cool and pleasant and are unusually well patronized. Shower baths, as well as apparatus, are always accessible.

The supervision of the play directing has been, as for several years past, in the hands of Prof. Carl F. Rothfuss, and the results have been most satisfactory. It becomes more clear as the work advances in St. Paul, that the direction and supervision of the play is one of the most important factors of the work. A young man and a young woman with special training have directed the activities on each ground.

It is the function of the playground and distinctly the duty of those who have charge to teach the children to play. Many children do not know how to play, and why is it? Is not play instinctive? And it is not children full of animal spirit who are the unmanageable ones, but more often those who do not care to play and would rather sit idly by, watching others. These are the children we have tried to reach in the past summer, and many examples of awakened interest have gladdened our hearts.

We find that the element of joy is strongly conducive to health and to make the children of our city happy is to assist in the great cause of civic reform.

The work has been along the same general lines as that of last year. The attendance was 225,000 for the year. Basket ball, centerball, baseball, field sports, swings, teeters, giant strides, slides, croquet, sandboxes, indoor games and the various minor attractions have maintained a steady hold upon the children.

Swings, teeters, sand-boxes, slides and merry-go-rounds are exceedingly popular with children, while gymnastic and athletic apparatus strikes the fancy of the older boys and girls.

Our gymnastic apparatus consists of:

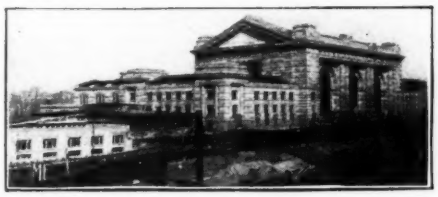
8 horses.
8 bucks.
8 parallel bar sets.
16 gymnastic frames, containing rings, ladders, bars, sliding poles, etc.

Our athletic and game facilities consists of:

6 baseball back stops.
4 tennis back-stop frames.
9 jumping sets.
3 sets iron goals for foot ball.
15 sets basket ball goals and posts.
9 shot-put rings.

Our play apparatus consists of:

17 giant strides.
26 swing sets.
21 teeter sets.
30 sand boxes.
12 merry-go-rounds.



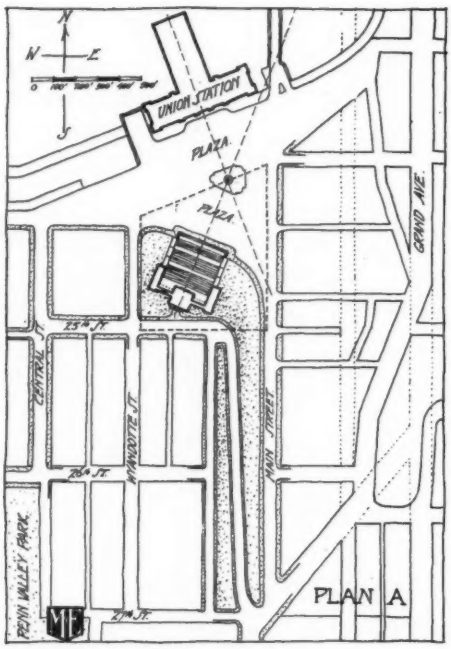
KANSAS CITY UNION STATION, *front on Plaza viewed from opposite direction from perspective view of Plan A. Under construction.*

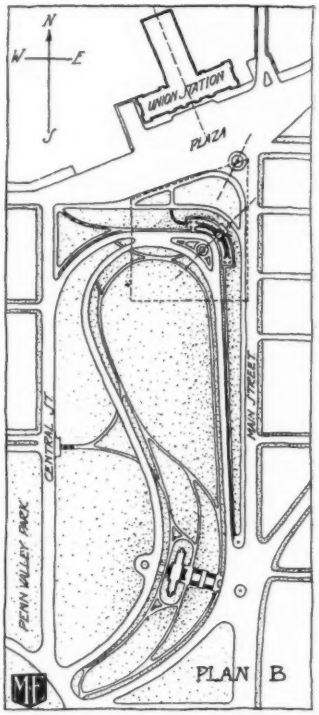
Beautifying Kansas City Union Station Surroundings

By Ben J. Lubschez, A. I. A., Kansas City, Mo.

The new Union Station which is nearing completion in Kansas City, has in front of it a plaza about 400 feet wide. Beyond this plaza is a bluff and high ground from 60 to 100 feet higher than the plaza. The Terminal Company building the station deeded 8½ acres of this

PERSPECTIVE SKETCH FOR PLAN A.





ground immediately facing the station to the city for park purposes. (See dotted lines on plans.) Main Street on the east of this property is being graded to meet the plaza level. This leaves the ground south of the plaza and west of Main Street high and inaccessible from the lower level. To grade all of this property would mean practically its confiscation, for the cost of grading would exceed the value of the property for many years. There is also the grave physical difficulty of there being no practical stopping place for the grading. The ground between Main Street and Grand Avenue on the east is also high, but on account of the great value of the property fronting on these streets, it is being gradually cut down by private owners.

The problem then resolves itself into terracing the bluffs at the edges of the high ground and adjusting the street grades to the Plaza and Main Street. This it is proposed to do in one of two ways: Plan A, proposed by the writer, and Plan B, proposed by the local park commission. As far as physical or rather topographical adjustments are concerned, the two plans are very similar, but Plan A is far more economical, taking only ¼ the frontage taken in Plan B, aside from the original 8½ acres deeded to the city.

Plan A differs mostly from Plan B in that it not only makes the high ground accessible from the plaza but leaves the greater part of it for use as hotel and apartment house sites, for which it is eminently suitable, and also in the treatment of the great terrace facing the station. This it is proposed to treat architecturally with monumental steps and crowning buildings. The plaza is enlarged and the ground lines and axes are balanced. In Plan B, all the high ground is taken for park purposes, there is no monumental architectural treatment proposed and altho the plaza is enlarged, no attempt is made to balance lines or axes. Tentative estimates show that Plan A, including architectural treatment, can be carried out in its entirety for less than the bare cost of acquiring the ground necessary for Plan B. It has been suggested that the crowning building in Plan A be a great art gallery, a suggestion for which is also made at the south end of Plan B.

Contracts are to be let immediately for the grading and terracing of the initial 8½ acres, shown by dotted lines on both plans.

WATER AS AN ELEMENT IN CONCRETE CONSTRUCTION

By H. A. Mark.

The occasional failure of important concrete structures, when subjected to floods or other unexpected conditions, indicates that low cost and profits are given more consideration than strength and durability. Then, again, from the writer's observations of the work of others, he is led to believe that while a careful study has been made of cement, sand, and aggregate, the function, purpose, and effect of water in the mix is little understood.

Cement, sand, and the coarser aggregates are inert solids without cohesive or adhesive power. Water, on the other hand, is a fluid without adhesive or sticking power to join two substances together. But water has a very strong surface tension. This is exhibited in what is known as capillary attraction. It is water that binds the inert materials together. This binding power is greatest when every particle of cement, sand, and aggregate is covered with continuous film of water. If too littl water is present, or if it is not evenly distributed, the water film will be broken. If, on the other hand, the thickness of the film is increased to the filling of the interstices between the aggregate this binding power decreases until it is nothing when the solid particles of the mix become immersed in the water.

In addition to being a binder of the solid elements of the mix, the water acts as a lubricant, allowing the solid particles to slip on one another and assume positions resulting in smaller interstices. This increases the density of the mass, and also the capillary attraction of the water film, provided there is not sufficient water present to destroy this film tension. When the excess of water destroys film tension the solids become separated or "suspended" in the fluid. The finer particles of cement "float" in the water filling the interstices or settle from the mass on agitation, and at the same time the "lubrication" of the larger particles is not increased.

It is the finer particles of the cement that develop the greater strength, but when suspended in the fluid or separated from the mass, the "hands" of these particles are not sufficiently long to bridge the water gap separating them from one another or from the larger solids.

This film tension and lubrication can be easily illustrated by a couple of pieces of window or ground glass. Press together and separate by drawing apart at right angles to the plain of contact. Repeat the experiment with the glass dry, coated with a thin film of moisture, and immersed in water.

It is far easier to build up the water film by careful addition of water than it is to distribute the water after it has been added. If excess of water is added to one part of the mix, so as to "float" the fine particles of cement, it is a question if the film tension can be restored by mixing this with drier materials. This kind of concrete may appear all right, but one part of the mass will not be sufficiently lubricated so the solids can assume the positions for greatest density, and the other parts will be over wet so that the particles of solids will be separated by excess water, and film tension will be lacking in either case. When water is poured or flows from a pipe or nozzle, this is sure to be the effect. The less nearly the cement fills the interstices of the aggregate the more pronounced the effect will be from improper watering. When the water is in just the right proportion to furnish the lubricating effect and the greatest binding power, these forces tend of themselves to draw the particles together into the dense mass.

The third property of water in concrete is to furnish the element that causes crystallization of the cement, giving to the concrete its strength. The observation of the writer leads to the belief that the crystal takes the best form when the water is present as just described. But this will not give sufficient water for the complete growth of the crystal. More water must be fed it during the time of curing in order to grow it to maturity.

So far we have dealt with only the ideal or theoretical requirements. Among all the methods, manners, and systems of mixing concrete, there can be only one right, or ideal process for each particular combination of materials to develop its maximum strength and durability. But this may not be the most economical from the cost standpoint. A given aggregate with a given proportion of cement will, when properly handled in the watering and mixing, give a definite result. But it may be more economical to increase the cement content and do the work in a manner that will not develop the maximum strength. But until one knows the requirements of developing maximum strength, and the question of

water is one of the greatest of these, he runs great risks in attempting to sacrifice construction efficiency to profits and low cost of construction.

The writer has used much bank gravel in concrete construction. He has found it economy to screen the fine from the coarse aggregate. Mix the fine aggregate and the cement, and then mix this with the coarse aggregate, thoroly drenched. Following thoro mixing, water as needed, is added by sprinkling until tempered to the proper consistency. The sand, fine aggregate, should be just sufficiently damp to cause the cement to adhere. This dampens the cement and establishes capillary attraction. The coarse aggregate has but little capillary attraction and, on mixing, its excess of water is taken up by the superior attraction of the finer materials. In this way the material is all bound together.

If the water is added to the mix of cement and sand, making a mortar into which to mix the coarse material, a very poor bond is established between the two classes of materials. If all of the materials are mixed together before the addition of water, it is very hard to add the water without washing the cement from the larger particles or drowning the cement and fine sand. What has been said of sand and gravel is equally true of sand and broken stone.

With proper watering and curing the same strength is developed with one-half the cement as with improper watering. And when the work is properly managed the cost is very slightly increased. This is true of either hand or power mixing. It is simply a question of whether it is best to add brains or additional cement to the mix.

Technical Associations

The National Association of Cement Users will hold its next convention February 16-20, 1914, in connection with the Chicago Cement Show, which is scheduled for February 12-21.

The 1913 exhibit of the Brooklyn Engineers' Club was held at the club house the week of April 15. It included water works equipment, coal hoist, engineering instruments, construction materials, the ozonator and moving pictures of road construction, welding, sewage disposal, etc. This is a practical idea which might be adopted with benefit by other societies not already in line.

The classification of exhibits of the Panama-Pacific International Exposition at San Francisco in 1915 is the most comprehensive ever prepared. It consists of eleven departments divided into 136 groups and subdivided into 800 classes.

The fifty-fifth annual convention of the American Society of Civil Engineers will be held at Ottawa, Ont., Can., June 17-20.

Le Mois Scientifigue et Industriel, 8 Rue Nouvelle, Paris, 9, which is one of the best of the monthly indexes of periodical and book literature on engineering subjects proposes to issue a cumulative index for the years 1906-1910, both inclusive, if it receives subscriptions enough at 6 or 8 francs, according to form chosen.

The Eastern Paving Brick Manufacturers' Association has been organized to aid in the work of the National Paving Brick Manufacturers' Association. It has absorbed the Pennsylvania association. The officers are: president, Charles E. Foster, of the Foster Paving Brick Co., Bradford, Pa.; first vice-president, J. B. Hammond, of the Bolivar Brick Co., Bolivar, Pa.; second vice-president, W. M. Hodges, of the Tuna Valley Pressed Brick Co., Bradford, Pa.; secretary, C. E. Young, with the Mack Manufacturing Co., with offices in the Arrott Building, Pittsburgh, Pa.; treasurer, C. P. Mayer, of the Mayer Brick Co., Bridgeville, Pa., who form the executive committee, together with Mr. Blair, of the Bessemer Limestone Co., Youngstown, O.; John Porter, of the Globe Brick Co., Wellsville, O.; John Hall, of the Westerman Brick Co., of Baltimore, Md.; Mr. McComb, with the American Sewer Pipe Co., Akron, O.; Joseph Nicholson, of the Toronto Fire Brick Co., Steubenville, O.; M. E. Gregory, of the Terra Cotta Brick & Tile Co., Corning, N. Y.; Warren DeRosay, of the Corry Brick & Tile Co., Corry, Pa. One important feature of this first meeting was the adoption of a uniform contract for the sale of paving brick and block.

The American Society of Engineering Contractors has issued an interesting booklet stating the purposes of the society which should interest all engineers and contractors.

The seventh annual meeting of the Playground and Recreation Association of America is held at Richmond, Va., May 6-10. A full program covering all parts of the field of this society has been arranged.

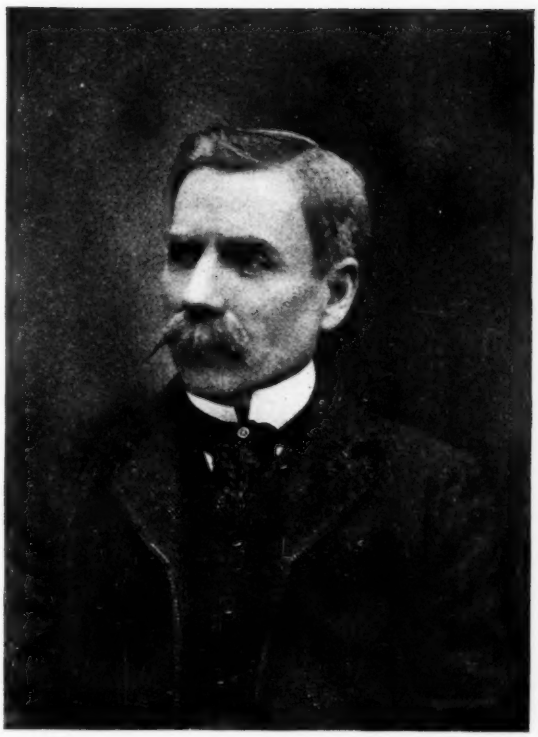
The fourth international congress on school hygiene will be held in Buffalo, N. Y., August 25-30. Dr. Thos. A. Storey, secretary general, College of the City of New York.

The January number of the Journal of the American Society of Engineering Contractors has a very comprehensive article by Geo. C. Warren on the "Development of the Modern Country Roadway," giving the practice in states with highway commissions with reference to macadam pavements, water and bitumen bound and going into some detail regarding the construction and maintenance of the better kinds of such road surfaces.

PERSONAL

A. Ormsby Graydon— A Reminiscence.

By George C. Warren, Boston, Mass.



Yours very faithfully
A. Ormsby Graydon

To George C. Warren Esq
Boston. Mass

London Ont. 7 1905

Mr. Graydon was one of the best known and progressive municipal engineers. Born in the township of London, Ont., in 1852, he resided thruout his life in the city of London and was chief engineer of that city for twenty years.

The following is extracted from the Toronto Globe, March 1, 1913:

"Ex-City Engineer A. O. Graydon died at Victoria Hospital at noon today, February 28, 1913. He had been ill a few weeks and was reported as recovering, so that his sudden relapse this morning came as a great shock to his friends. Mr. Graydon was the son of the late Simpson H. Graydon, ex-mayor of London, and was born in this county in 1852. As a young man he entered the city engineering department, succeeding in 1891 to the post of city engineer, which he held for practically twenty years. Latterly he had been living in retirement at the family residence on Dundas street. His step-mother, five brothers and two sisters survive."

In connection with Mr. Graydon's life and illustrating his professional foresight, an interesting incident is indelibly stamped on the memory of the writer which seems to be worth repeating here in connection with his death.

In May, 1901, MUNICIPAL ENGINEERING published an article regarding some experimental work by the writer's brother, the late Fred J. Warren, outlining the principles of what has since developed into the Bitulithic pavement, then little more than a clearly defined thought in the inventor's mind following two years of laboratory research. The first of twenty-six succeeding patents had just been allowed and in the presence of a number of municipal engineers, an experimental area of the new pavement was laid in the driveway of the factory of

Warren Brothers Company at East Cambridge, Mass. Regarding the experiment MUNICIPAL ENGINEERING in the May, 1901, issue said in part:

"This seems to be the first piece of pavement laid on the principle of using stone of predetermined variation of size and completely filling the voids, the stone being larger than ¼ inch. The principle on which the work was based apparently received the approval of the practical road builders present and the outcome of the experiment will be watched with much interest. The attack of so interesting a problem as this in the manner described is worthy of attention, and whether the roadway is successful or not, the effort to reach the valuable truth in the theory is worthy of great commendation. Several of those present expressed their intention of laying some pavement on this plan during the year."

(Here an apparatus used in making screen and void tests was described.)

"Assuming that any even-sized grain yields from 40 to 50 per cent. of voids, a result can be obtained by measure in ten minutes after taking sample. For most accurate determinations weights must be taken, which will prolong the operation about an hour. A stone properly graded according to Mr. Warren's theory, will increase in volume about 30 per cent. when separated into the varying sizes by the screens, 1,000 cubic inches becoming about 1,300 cubic inches."

This briefly outlines the basic principles of the bitulithic pavement. In the twelve years of practical developments which have followed, the principle thus attained has not been changed, altho there have been constant improvements of detail in carrying out the principles. The city of Pawtucket, R. I., was the first municipality to adopt the then new pavement in practical street construction. A. Ormsby Graydon, the progressive city engineer of London, Ont., was the first to write to the inventor, immediately following the publication referred to above, expressing his approval of the principles outlined, and predicting that the invention would prove to be a practical success. Unfortunately about three years ago this letter with other mail was lost, but, as stated above, this early encouragement as well as subsequent endorsement is indelibly stamped on the writer's mind and he believes it is fitting to chronicle the incident at this time in connection with the passing of our friend from bodily presence with us.

For ten years the accompanying photograph with Mr. Graydon's autograph has hung in the writer's office and has been highly prized as a photograph of the writer of the first written professional endorsement of bitulithic pavement by a municipal engineer.

Personal Notes

Walter T. Lemon is president of the Board of Public Works of St. Paul, Minn.

George H. Biles, of Harrisburg, Pa., has been appointed superintendent of maintenance of state highways for Pennsylvania.

H. F. McDonald and C. D. Brown have opened offices at 904 Confederation Life building, Winnipeg, Man., as consulting engineers and land surveyors.

Charles V. Seastone has been taken into partnership with Professor Daniel W. Mead of the University of Wisconsin in his consulting engineering practice at Madison, Wis.

Rodney Smith is city engineer of Auburn, Me., and F. I. Bisbee is superintendent of water works, by re-election.

J. A. Wilson has been appointed city engineer at Kamloop, B. C.

A. A. Kirkwood has been appointed city engineer of Forest Grove, Oregon.

W. N. Willis has been appointed city engineer of Spartanburg, S. C.

Hugh Gall has been appointed assistant county engineer of York county, Ontario.

W. Leroy Ulrich, of Manchester, Conn., has been appointed special assistant to the state highway commissioner of Connecticut.

John V. Fitzgerald is superintendent of streets of Revere, Mass.

R. E. Snowden, highway engineer of Snowden, N. C., has been appointed engineer in charge of construction and maintenance of roads of Craven county, N. C.

Dr. Homer M. Deer, professor of civil engineering at the South Dakota State College has been appointed state engineer of South Dakota.

E. A. Kingsley, 716 Southern Trust Bldg., Little Rock, Ark., has been appointed engineer in charge of street paving work of street improvement district No. 1 in Woodruff county. About 30 miles of road will be built at a cost of $100,000 during the coming summer.

James Nesbit Hazlehurst, of Atlanta, Ga., has been commissioned by the authorities of La Grange, Ga., to draw the plans and specifications for a gas plant, to be constructed and operated on municipal account, to be ready by June 1st. Mr. Hazlehurst will also arrange for the construction of a water plant, and will have supervision of the construction of both systems.

J. Frank Bowen has been appointed city engineer of Manchester, Vt.

Geo. W. Sparks has been reappointed a member of the Board of Street and Sewer Commission of Wilmington, Del.

E. C. Wilson and T. A. O'Donnell have been elected city engineer and street commissioner, respectively, of Waterville, Me.

Andrew J. McCrudden has been appointed borough engineer of Lansdowne, Pa.

J. A. Foster and E. A. McLaughlin have been elected chief engineer and road commissioner, respectively, of Winthrop, Mass.

W. D. Beers, of Salt Lake City, has been appointed state engineer of Utah.

George Sullivan has been appointed special supervising engineer for Lexington, Ky.

H. A. Brazier has been appointed assistant engineer for the city of London, Ont.

Arthur H. Blanchard, M. Am. Soc. C. E., professor of highway engineering, Columbia University, recently delivered addresses on "Modern Bituminous Pavements for Municipalities," before the Board of Trade of Elizabeth, N. J., and on "Highway Engineering in Europe and America," before the Brooklyn Institute of Arts and Sciences.

M. H. Baker has been appointed city engineer of Prince Albert, Sask.

J. K. McGrath has been appointed principal assistant to the chief paving engineer of Baltimore.

Albert Wolstenholme has been appointed superintendent of streets and surveyor of highways for Fall River, Mass.

B. B. Weber has been elected city engineer of Oil City, Pa.

W. H. Beeman, of Montreal, P. Q., has been appointed Civic Commissioner of Sherbrooke, P. Q., in charge of road work.

Charles M. Talbert has been appointed street commissioner of St. Louis, Mo.

Clifford Richardson has moved his offices to 1615 Woolworth building, 233 Broadway, New York City.

J. Leopold & Co. have moved their offices to the Woolworth building, 233 Broadway, New York City.

Edward O'Brien has been appointed street commissioner of Medina, N. Y.

N. R. Harmon has been appointed county road engineer of Marion county, Ky.

Charles A. Roamer has been reappointed county superintendent of highways of Rensselaer county, New York.

John E. Field has been appointed state engineer of Colorado.

E. R. Morgan has been appointed state road engineer of Utah.

H. P. Parsons has been appointed city engineer of Petersborough, Ont., at a salary of $2,500.

Z. E. Sevison has been appointed city engineer of Laramie, Wyo. He is also county engineer of Albany county.

Curtis Hill has been appointed provisional city engineer of Kansas City, Mo.

Mellis B. Ferguson has been appointed city engineer of St. Thomas, Ont., at a salary of $2,000 per year.

Mr. Holland has been appointed city engineer of Guelph, Ont.

Sylvester Q. Cannon has been appointed city engineer of Salt Lake City, Utah.

C. W. Marx is now associated with J. A. Stewart, C. E., in the practice of civil engineering at 1112 Traction building, Cincinnati, O., paying attention to steel and reinforced concrete, difficult foundations, steam heating, ventilation, factory engineering, sewerage, pavements and surveys.

Technical Associations

The International Civic Bureau, 1 Madison avenue, New York, under an advisory board and a committee of arrangements selected from officials in various national civic organizations and a large number of European authorities as well as the local officials of cities to be visited, has arranged four tours of Europe for the observation and study of civic, social, industrial and asthetic problems in various cities in Germany, Austria, Belgium, Holland, France and England. Itineraries of the tours covering July, August and September, 1913, are ready for distribution.

The Mayor's Society of New Jersey, is in its second year and has about fifty members. Frederick W. Donnelly, mayor of Trenton, is president and Frank J. Murray, mayor of Orange, is secretary and treasurer. The society is working upon the appointment of an expert in municipal work as permanent secretary who will be an efficient aid to the members officially and individually.

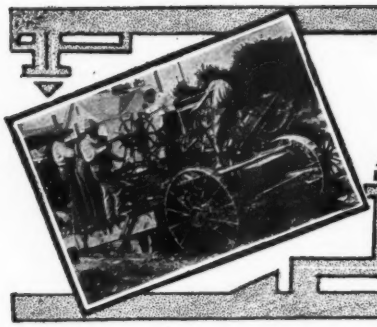
The National Old Trails Road Association held its second convention at Kansas City, Mo., April 29, 30. The program was full of push for the coast to coast highway on this line.

Ernest F. Jonson presented at the April meeting of the Municipal Engineers of the city of New York an illustrated paper on methods of inspection of materials of construction used in connection with the Catskill aqueduct.

Technical Schools

The engineering experiment station of the Iowa State College of Agriculture and Mechanic Arts, at Ames, has published Bulletin 26 on "The Production of Excessive Hydrogen Sulfid in Sewage Disposal Plants and Consequent Disintegration of the Concrete," by W. M. Barr and R. E. Buchanan, which gives the reason for observed deterioration of concrete about such plants.

Illinois Central locomotive No. 958, loaned to the University of Illinois for testing purposes, is the first to be tested in the new testing plant. It was received April 11.



MACHINERY AND SUPPLIES

Thomas Reinforced Concrete Pavement in Detroit

By N. H. Beasley.

The use of concrete in road construction work has received great advancement thru the Thomas system of steel reinforcing for pavements, which has been attracting more than ordinary attention in and around Detroit during the past two or three years and this spring the Detroit board of public works has provided, in its estimates, for the paving of a number of streets in the western part of the city with concrete.

The Thomas system was put to an exhaustive test on Parkview avenue, which leads from Jefferson avenue to the public

REINFORCED CONCRETE PAVEMENT *in Detroit, on a first-class residence street.*

lighting station. There is extremely heavy traffic over it and in previous seasons it was necessary for the board annually to make improvements in the cedar block pavements or relay them entirely. The Thomas system was tried out and has given entire satisfaction.

Six points were considered when the Thomas system was originated: Comparative durability of different kinds of paving material. The best way in which to lay pavement to obtain the best results. The actual wear. The best method for cushioning pavements. The safe limit of load and speed. The best mixture for concrete roads.

The type of pavement invented by A. O. Thomas, a practical civil engineer, is practically noiseless, even less noisy than sheet asphalt, and from the nature of its combination is free from dust. Its surface has a moderate degree of roughness, thus preventing skidding of automobiles and the danger of falling by animals. In Detroit this feature of roughness is practically necessary. There are more motor cars on the streets of Detroit than in any city in the country and there is always a demand from the motorists for a pavement that will eliminate this danger as much as possible.

The Thomas pavement is one, also, that appeals to the taxpayer. It can be laid at a price as low as, if not lower than, cedar block and many types of asphalt macadam. It will outwear cedar block; it is low in first cost, requires little repairs for a number of years and has the attractive qualities of the high-priced pavements.

One great difficulty that was overcome by Mr. Thomas in his system was the danger of cracking. Plain concrete has a tendency to shrink during the hardening process and it is also susceptible to expansion and contraction under changes in temperature. The tendency to crack has been overcome in this system by the proper distribution of steel thruout the mass, thus taking care of all the stresses developed. The actual laying of pavement during freezing weather has demonstrated the practicability of the plan. In case of repairs for the laying of sewers, gas pipes or water pipes, the repairs can be made as cheaply as with any other pavement. Resurfacing can be done very cheaply and in a permanent manner without affecting the foundation, which remains undisturbed, securing a smooth appearance.

Method of Laying

Generally the two top bars are placed 2 feet center to center and those at the bottom 4 feet center to center, but this may vary according to latitude and climatic conditions. The vertical supports or stools are made of light angle iron sheared at the bottom so as to bend the

METHOD OF SETTING UP *reinforcement for Thomas pavement.*

feet which give a bearing on the grade surface of the road. Two sets of parallel horizontal bars are placed transversely and longitudinally and firmly attached to the vertical supports by a simple device which clinches the bars when engaged in the support. The support is the most important member in the system. It takes hold of the bars and fixes them between its wings. If expansion joints are used every 30 feet and the street is 24 feet wide, the location of these supports, which are generally placed 4 feet on centers, makes a large stone 24 feet wide by 30 feet long, composed of small stones 4 feet by 4 feet, without any joint between the small stones. The method used in constructing an expansion joint prevents any crack in the concrete between the reinforcing bars and the plate of the expansion joint. In other words the structure must act as a unit. The top bars of steel are heavier because they are nearer the top of the pavement and subject to greater differences in temperature. The bottom bar is heavy enough to take care of any strains that would be caused by an irregular motion of the mass of concrete due to the friction between the uneven surface of the subgrade and the concrete slab, particularly under the influences of arched sections or the formation of ice under the pavement if water gathers there in freezing weather to produce an upward pressure. The reinforcement besides taking care of the shrinkage causes the concrete to act as a beam and prevents any cracks or depressions when heavy loads pass over the surface.

George Jerome, surveyor, civil and municipal engineer, in Detroit, had this to say of the system:

"I believe the Thomas system of reinforced pavements is one of the best ever devised and I am recommending it in every paving proposition that comes before me. I have just finished my second season in the use of the system and it certainly has given satisfaction. The first street I laid was in November, 1910, and after exceedingly cold winters and hot summers there is not a crack visible. Since that street was laid I have put down three miles more and at first there was considerable opposition to the pavement because of the general impression that concrete cracked too easily. There have been no complaints of this nature regarding the Thomas system. The City of Detroit paved Elmwood avenue, a street about one mile in length, the following summer and the Thomas system was not used. The concrete now shows numerous cracks. At first I was opposed to concrete but I have been won over to the Thomas system by the results attained by placing your material and it has met my most sanguine expectations."

Sewer Pipe in Large Sizes

By L. G. Blackmer, Blackmer & Post Pipe Co., St. Louis, Mo.

The continued demand for our large sizes of vitrified pipe, 27, 28, 30, 33, 36, 39 and 42-inch, for sanitary and storm sewers, and for railroad culverts, gravity water mains and other uses, has fully justified the additional buildings, kilns, machinery and equipment for their economical production and handling that we completed in 1910. In fact, the demand for these sizes is now exceeding the capacity then provided, and we are arranging to make further additions, which will increase our output. These additions, when completed, will give us a capacity greater than that of any other exclusively vitrified clay products plant in the United States.

The popularity of our 27 to 36-inch pipe encouraged us to think that even larger sizes would meet with equal favor, and we have been assured by many prominent engineers that they favor the use of vitrified pipe in the largest diameters it can be made, and that they would give it preference over any other material for sewers. These declarations made

us decide to undertake the manufacture of 42-inch pipe.

With the knowledge which comes from experience we have been enabled to steadily decrease the cost of manufacturing by reducing the percentage of loss in burning, and at the same time improve the quality of the finished material. There is now no doubt that when the cost of transportation is not excessive, our large sizes of vitrified pipe can be laid in the ground as cheaply as the corresponding sizes of brick sewer.

Sanitary engineers generally freely concede that a hard burned vitrified pipe with smoothly glazed inner surface, properly laid, and the joint carefully made with gasket and cement, has 20 to 25 per cent. greater capacity than any other sewer of the same size, which, however carefully constructed, cannot be made as smooth as a salt-glazed vitrified pipe. The difference in capacity is due to the decrease in frictional resistance.

A much wider trench is required in which to construct a brick or concrete sewer, which adds materially to the cost of excavation and back-filling, for it is obvious that when the brick sewer requires walls of 8 inches, not only does this entail additional excavation over and above that required by the thickness of the material for the pipe sewer, but there must be room enough left at the spring line between the sheathing and the finished arch for the bricklayers to properly do their work.

The substitution of a 30-inch vitrified pipe for a 32-inch brick sewer would give about 15 per cent. greater capacity and save nearly 40 per cent. in the width of the ditch, the 30-inch pipe requiring only 42 inches in width and the 32-inch brick sewer, with two rings of brick, taking up 56 inches in width. This not only means a saving in excavation, but in the generally crowded condition of city streets, with water and gas pipes, and wire conduits underneath and car tracks on the surface of the same, the saving of 14 or more inches in width might permit of sewer construction without the moving of any other underground work or car tracks, thereby keeping the streets open to traffic instead of blocking them off, as is so commonly done.

It is a fact of some importance that the pipe sewer may be constructed more rapidly, two able-bodied expert pipe layers being able to lay the pipes and cement the joints about as fast as the pipes can be lowered into the ditch by a derrick.

The Board of Health of London, England, after a thorough investigation of the comparative merits of brick sewers and vitrified pipe, in their general report say:

"The general use of large brick sewers has resulted from ignorance or neglect. Such sewers are wasteful in construction and repair, and costly through inefficient efforts to keep them free from deposits. Brick or stone house drains are false in principle, and wasteful in the cleansing, construction and repair. House drains and sewers properly constructed of vitrified pipe retain and accumulate no deposit, emit no offensive smells, and require no additional supplies of water to keep them clean."

Never having determined by actual and intelligent test the external pressure our large sizes of vitrified pipe would stand without breaking, and believing that reliable information regarding same would be desirable in making comparison of the merits of brick sewers and pipe sewers, we selected from the stock in our yard this material, which was sent to the works of the Geo. J. Fritz Foundry and Machine Co., 2038 South Third street, St. Louis, where each section of vitrified pipe was tested, with results as shown:

	Lbs.
1 section 24-inch double strength vitrified pipe, 2 inches thick, broke at	27,610
1 section broke at	28,715
1 section 27-inch double strength vitrified pipe, 2¼ inches thick, broke at	33,133
1 section broke at	32,763
1 section 30-inch double strength vitrified pipe, 2½ inches thick, broke at	27,987
1 section broke at	24,297
1 section 27-inch standard vitrified pipe, 2⅛ inches thick, broke at	23,986
1 section broke at	22,530
1 section 30-inch standard vitrified pipe, 2¼ inches thick, broke at	27,875

(Signed) H. R. GATES,
Supt. Geo. Fritz Foundry and Machine Co., 2038 South Third St., St. Louis, Mo.

Resurfacing Old Pavements

By W. K. Cooper, Sec., Union Asphalt Construction Co., Indianapolis, Ind.

On the subject of repaving and repairing old pavements by means of the Lutz surface heater, we beg to submit the following:

We have one of these heaters, and we think well of it. We have not had, as yet, the opportunity in Indianapolis to use it in resurfacing a large yardage of old pavements. Some two years ago we selected, as an experiment, and with the approval of our city civil engineer, the south half of intersection of Meridian and South streets to use in resurfacing the old brick pavement in this intersection, with the Lutz surface heater. This

is an intersection where much heavy hauling exists. It is located between the wholesale district and freight depots. This will indicate to you, in a measure, the extent of the heavy traffic to which the intersection is subjected. To look at the intersection today you would never know that an old worn-out brick pavement was underneath the asphalt surface, and the asphalt top is in as good condition now as it was when laid two years ago. We have had city officials from Terre Haute and other neighboring cities to inspect it and all have been pleased with it.

In our judgment it will be no mistake to introduce this heater into cities having worn out brick or asphalt pavements, and use the same, in resurfacing, to the end that you will have a new modern pavement where before was a street unsatisfactory to all traffic. We have done very little street patching with the heater for the reason that we have had very little work of this character to do up to the present time.

Irrespective of the construction, any pavement will need repairs in time, whether from wear and tear, expansion and contraction, or improper repairing of excavation. What is done in the repairing of old pavements should be done in such a manner as to be most efficient, economical, and without any sign of where the patch or repairing was done. There is no gainsaying the fact that it is better to resurface the majority of our old worn out brick, cobble-stone and asphalt pavements than to tear them up and relay entirely new pavements.

Cutting out and plugging in methods of repairing asphalt pavements leave unsightly signs of the repairs made. It takes time to do a lot of the details necessary in thus repairing such a pavement and very often it has been shown that in such cases the joint between the patch and the old pavement has not been sealed, due either to what is known as a dirty joint or to carelessness on the part of the laborer in not painting over part of the exposed edge of the depression.

This condition is easily observed when, after a rain, the sun has dried up the surface of the pavement, while the patches are definitely outlined by a wet line. Another source of trouble comes from the pushing or displacement of patches because of the material used. The patching material should be as nearly as possible of the same consistency as the old pavement, so that when the summer's sun warms up the pavement, the old and the new material may soften to the same degree. The folly of using a new street mix as patching material in an old pavement has frequently been examplified.

A temperature variation of from 5 to 10 degrees below zero to 120 or 130 degrees in the summer's sun, on the surface of the pavement, presents a complex problem concerning the proper mixture to be used. Under slow-moving, heavy loads in the summer, the material is apt to push or creep, bringing about a wavy or undulating condition of the surface. Such a pavement is very "bumpy" to the automobilist. This condition can frequently be remedied by the use of Lutz surface heaters. By this means, the bumps or high places are softened and all the burned and soft material is scraped off, leaving a clean surface of the old material. Such burning should be continued until the burned area will require at least 1 inch of added material to restore the pavement to its proper surface and cross-section. In almost every case, it is well to cut a joint at the edge of the burned area, 1 inch or 1½ inches deep, so that the edge of the old pavement may serve as a shoulder for the new material.

The importance of asphalt maintenance manifests itself more and more to the city officials and tax payers as the maintenance under the original contract expires. It then becomes the duty of the officials to maintain these streets in the most economical way. The old way of chopping out is expensive and not satisfactory for these reasons: The new, hot material does not weld or vulcanize onto the old, cold pavement, even though painted with hot liquid asphalt. There being no union between the old and new material, cracks open up, admitting destructive elements, causing decomposition to set in. The result of such methods is a garment of many patches soon necessitating replacement.

The Lutz method consists in drawing a large volume of air, heated to the proper temperature, from a heating chamber and blowing it with great force upon the asphalt or other bituminous pavement thereby gently heating and softening without flame the old pavement to the same consistency as the new material. Then with the use of hoe and rake all disintegrated materials, uneven or worn surfaces are removed and joints cut, and while the pavement is still hot sufficient new material to bring up the grade and contour of the street is added. The temperature of both materials being at the vulcanizing point, when tamped, smoothed and rolled a perfect weld is produced, leaving a finished surface. Instead of having a patch, the repair becomes a part of the whole.

One-Piece Gutter Inlet

The Municipal inlet was designed to meet the conditions where the existing catch basins are in a position other than

on the line of the curbs of a proposed street improvement. The catch basins are sometimes located and built at fixed distances from the center lines of the streets when the sewer system is installed, and consequently will be in the line of the curb for one width of roadway only. This means that it will be found generally necessary to convey the street drainage from the gutter to the existing catch basins by means of an inlet and sewer pipe connection. The old method of providing for an opening thru the curb and connecting thence to the catch basin brought the pipe connection within a few inches of the surface of the parkway, which can readily be seen was poor construction.

The Municipal inlet is a one-piece iron casting set in the curb and gutter, and on account of the goose neck design, makes its junction with the sewer pipe connection to the catch basin well below the parkway. On account of its hooded height above the surface of the gutter, it is almost impossible for the inlet to become clogged, and it is easily rodded or flushed.

Where the street improvement provides for curb and gutter, the inlet is set in accurate position and the concrete merely tamped around it, allowing of the uninterrupted construction of the curb and gutter. This feature will appeal both to the engineer and contractor. The appearance of the street being important, it will be noted that this inlet when in place presents a pleasing and inconspicuous effect. This patented inlet is made by the Municipal Inlet Co., Chicago.

Drinking Fountains in Menasha

By Ira H. Clough.

The city of Menasha, Wis., maintains several municipal watering fountains, popularly known as "bubblers," which are purchased from the Gier & Dail Mfg. Co., of Lansing, Mich. Four of these fountains were purchased by the city of Menasha little more than eight months ago, after a heated debate among the members of the common council. Today no stauncher admirers of this sanitary form of public drinking fountain can be found than the city officials who were most determined in denouncing the plan for the proposed purchase of the fountains. One of the drinking fountains is located in the city park and three others are distributed promiscuously about the various portions of the business district of the city.

A report of the city park commission shows that more than five hundred adults and children visited the drinking fountain at the city park on a single day of last summer. The accompanying photograph shows one of the drinking fountains in winter attire, stripped of the drinking cups and water pipes, but ornamental in appearance despite this handicap. The continual flow of water during the seasons of spring, summer and fall renders the Gier & Dail drinking fountain a leader from the point of sanitation.

GIER & DAIL FOUNTAIN *installed at Menasha, Wis.*

All of the water passing into the fountain passes thru the drinking cups, a feature heartily indorsed by state health inspectors. The fountain is 7 feet in height, and an ornamental dome, electrically lighted, makes the fountain an object of beauty both day and night. During the big home-coming celebration, when Menasha entertained more than fifty thousand out-of-town guests, the drinking fountains were offered and accepted as an important evidence of the city's advancement. Merchants have contributed liberally toward the cost of lighting the fountains and have offered a personal guarantee to provide for the repair of the fountains in case they should show the effects of wear or weather. The purchase of several additional fountains, to be stationed in the residence districts of the city, is being contemplated by the city council at the present time.

The Directograph Pitometer

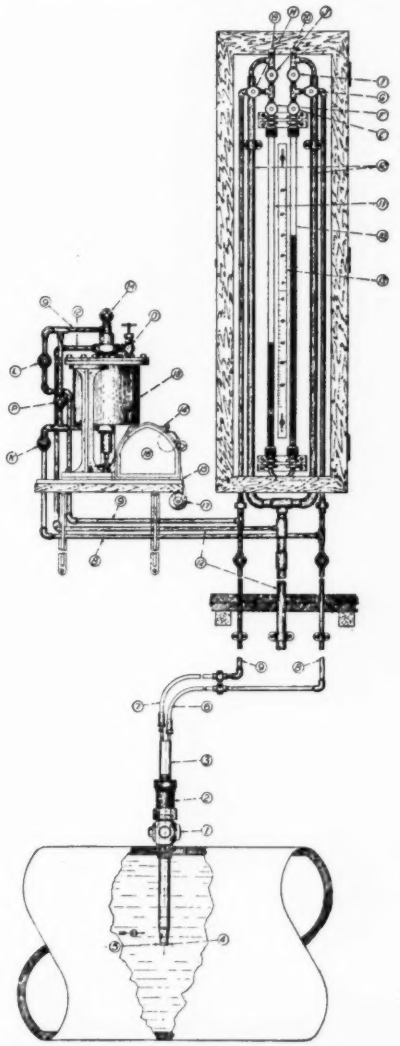
The Municipal Supply Company, Western Union Bldg., Chicago, have quite recently invented and placed on the market the Directograph Pitometer, an instrument for recording rates of flow in pipes, etc., measured by Pitot tubes, Venturi tubes or other devices in the use of which the result desired is obtained by the measurement of the difference between two pressures. The instrument has been designed for use in connection with a Pitot tube for measuring the rate of flow in a water main. The Pitot tube is of an improved form, having two orifices or pressure openings and connected with pressure tubes passing through a metal casing of such form and length as will permit its insertion into a water main through a one-inch opening and allow it to be set at any point along the diameter of the pipe. These two pressure tubes are connected by means of rubber or metal tubes to a glass "U" tube containing a liquid slightly heavier than water, thus forming a good serviceable indicating flow meter for use in cases where a short test measurement is desired on any pipe line.

When it is desired to obtain a continuous record of the rate of flow, from which the total of any line, as, for example, a pumping station discharge, is to be computed, the recording device is connected in parallel with the "U" tube. This arrangement allows the instrument to be used either for indicating or recording the rate of flow and furnishes an absolutely reliable means for checking the adjustment of the recorder.

The recorder consists of a collapsible metal box or bellows, containing a heli-
By Wm. A. Braden, Treas., The Braden
cal spring made of phosphor bronze, enclosed in a cylindrical brass case in such a manner as to form two separate pressure chambers. The upper chamber or inside of the collapsible box is connected to the up-stream or impact orifice of the Pitot tube, and the lower or outer is connected to the down stream or trailing orifice. If there is no flow in the main line the collapsible box will stand at a normal position of rest, as the pressure in both chambers will be equal, but if the water in the main is in motion the pressure on the upper chamber is greater than in the lower chamber and the bellows is extended a distance which is dependent upon the amount of difference between the pressure of the two chambers, and the resistance of the helical spring. This thrust, transformed by means of rollers and cam into a rotary position, is transmitted thru a frictionless packing gland to a pen arm, and thence to the paper chart.

A one-inch cylindrical opening is made in the water main, usually by means of a one-inch corporation cock, as shown at (1). To this cock is attached a "new type" stuffing box (2) which is so arranged that the "new type" pitometer rod (3) can be removed to any position along the diameter of the pipe and rotated so that the axis of the orifices (4) and (5) can be made parallel to the axis of the pipe.

These orifices are set at various known points across the pipe, and the ratio of the mean velocity at this cross section of the pipe to the velocity at the center, or some other known point is determined. This operation is termed "traversing," the result being the "pipe coefficient."



THE DIRECTOGRAPH PITOMETER.

With a flow in the direction shown by the arrow, orifice (5), the impact orifice, receives a greater pressure than the "trailing" orifice (4). These pressures are transmitted thru separate openings in the rod, thru the flexible tubes (6) and (7), and thru the pressure pipes (8) and (9) and to the glass tubes (10) and (11) to the new type of indicating differential gage and also to the low and high pressure connections (8) and (9) of the Directograph recording differential gage.

The differential pressures are indicated in the "U" tube by the rise and fall (termed deflection) of a dark red colored liquid, having a specific gravity greater than water, and are read on an adjustable double scale (13) which can be graduated to read in terms of feet velocity per second; gallons per minute; gallons per 24 hours; pump revolutions or otherwise (so that no other calculations of any kind are required).

The directions for filling the glass tubes with the red fluid are as follows:

Close valves (G) and (H) on the pressure pipes (8) and (9), then open the valves (E), (F), (I) and (J), unscrew and remove either plug (19) or (20), insert funnel and pour in slowly the red liquid until it fills both glass tubes to zero on the adjustable scale.

After the tubes are filled as above with the liquid, close valves (E) and (F), then open valves (G) and (H), allowing water from the main to flow freely out thru the overflow pipes (12). The object of this operation is to allow any air which may be in the pressure pipes or flexible metallic tubes to escape. Such air will readily escape since the pressure pipes are installed on a rising grade and the overflow or blow-off valves (I) and (J) are at the highest point in the system. By operating the valves (I) and (J) in conjunction with the valves (E) and (F) the air can also be blown out of the glass tubes, thus freeing the entire "U" tube of air, which is the essentially important feature to the correct operation of the instrument.

Valves (K) and (L) control respectively the low and high pressure of the "Directograph Recorder" (18). Valves (M) and (O) are blow-off valves which allows the air to be freed from the high and low pressure chambers of the recorder. Valve (P) being the by-pass or equalizing valve should be open to partially balance the pressures in the two chambers, before valves (M) and (O) are opened. Valves (M) and (O) should be manipulated as to keep the pen (14) within range of the paper chart (15) thus avoiding excessive pressures on the sensitive diaphragms which separate the high and low pressure chambers and transfer the differences of the pressure to the actuating mechanism of the pen arm.

The paper recording chart is in the form of a continuous ribbon about four inches wide and is drawn at the rate of one inch per hour by friction rolls which in turn are driven by means of a power clock (16), thus giving an unbroken direct graphic record of the rate of flow from hour to hour thru the pipe. It will be noted that this recording chart is visible at all times, which is very important. Every variation in the rate of flow in the pipe, together with the time and extent of such variations is permanently recorded on the chart, which is always visible.

Washing San Francisco Streets

By Peter J. Owen, Supt. of Street Cleaning Dept., Board of Public Works, San Francisco, Cal.

We have been operating a number of Squeegee machines on our smooth surfaced, as well as brick, pavements with great success. We are cleaning about 30,000 square yards per day with minimum water consumption.

The sprinkling attachments do not operate under pressure and consequently the water is not placed upon the pavements with sufficient force to wash out or break up the brick filler or otherwise pound or injure the pavement. The water is applied to the surface in gentle fashion and as it raises no splashing or dust the machine can be operated in the day time on our most heavily congested streets. The machine is noiseless in its operation and as the scrubbing work done by the squeegee is minus all throwing of dirt and slime no discomfort is caused to vehicles. The revolving rubber squeegee takes up every drop of water and uses same in thoroughly scrubbing the pavement. These machines remove every particle of oil and grease and leave the pavement in a thoroghly sanitary condition.

We are using this type of machine very extensively in view of the fact that it does the work of a sprinkler and flusher in one operation. It consumes about one-third of the water required by ordinary sprinklers and flushers.

Guide Post for Municipalities

By William A. Braden, Treas. The Braden System Company, Chicago.

We need a better way of guiding the traffic in the downtown section of our cities, where we should pass each other in an orderly and systematic manner at the street crossings.

We should remove some of the danger

of passing automobiles on the boulevards where the street cars or steam railway trains cross, by automatically giving the cars or trains the right of way and flashing the danger signal on the boulevard traffic in time to avoid serious accidents.

We should have the names of streets placed in conspicuous position on the corners at the intersections.

We all should know where north, south, east and west actually are.

We should know what the names of the nearby streets are when we are strange in a section of a city.

We should know where to find a fire alarm box anywhere in the city at a moment's notice, without asking questions, and we should have the box located where it is the most noticeable object in sight when we are mailing letters; thus acquainting all where the fire alarm box is.

We should have all the public phones and the various apparatus, more particularly the mail and package boxes housed in a neat receptacle that will enhance the general appearance of all neighborhoods.

We want these guide posts illuminated at night by electric lights in such a manner that the street illumination has a more artistic effect, and is more useful, by giving us a street name that we can see at night as well as by day.

We should know at a glance the hour of the next mail collection without consulting a book of rules or asking questions.

The Braden System Guide Post and Utility Column is a useful ornament, 12 feet high and 30 inches square.

The traffic controller is incorporated at the very top of the guide post, above the street name sign, while just below is a guide which shows the various directions, north, south, east and west.

About 4 feet lower a local street guide shows the names of the next six streets in each direction with street numbers at intersections, also the various railroad stations and various roads entering same.

Immediately below this street and railway guide are located the various public phones and the fire alarm box.

Just below the letter box opening is an automatic indicator that gives minute and hour of the next mail collection.

The package box is just below the letter box, both of which are constructed in such manner that the mail collector can more readily remove the contents. He can observe the interior at night as well as in the day time, because the boxes are both illuminated so that he can see what he is doing. The light from the external illumination of the column is transferred through perforations.

THE BRADEN *Municipal Guide Post.*

The letter box opening and the next collection indicator are illuminated at night for the convenience of those who have occasion to mail letters after dark.

The fire alarm box is placed in the Braden system guide posts immediately above the letter drop to automatically educate the populace that the fire alarm box is where they mail their letters and is therefore available in emergency for action without hesitation or question. Many more guide posts than fire boxes will be placed, therefore, the posts have transparent red glass sections on all four sides just above the local street guide, which are of themselves ample notification in the day time and many times more noticeable at night. On the inside of the red sections is an electric lamp

which is illuminated the instant the fire alarm door is opened, to notify the local patrolman.

There is a space also in the guide post for the police department phone which under some systems has a vibrating electric ball or buzzer to call the police officer, which is just as likely to disturb a miscreant doing a little job.

The illumination below the fire and police boxes is to help out the general effect. The local street guide is illuminated at night.

The traffic controller is useful in congested districts to the traffic squad by placing one guide post at each corner of the crossing, four in all, controlled from one predetermined column and electrically connected to work in unison and pairs in such manner, for example, that the traffic going east and west has the right of way over that going north and south, or vice versa, as desired by the operator.

Where street railway cars cross a boulevard two posts or columns are arranged at the right hand sides of the boulevard traffic; the semaphore or traffic controller in this case gives the traffic the right of way, except when a street car approaches the danger zone and is about to cross, when the stop signal is displayed automatically and does not require an operator unless there is excessive traffic on the street on which the car runs.

The usefulness of our guide posts is almost unlimited. A case in point is, for instance, San Francisco, Cal., where they are preparing to entertain the whole of the earth, they will want those people to know where and how they can get the worth of their money day and night. The guide post in districts where announcements are desired will tell the people where to go and how to get there during the early daylight hours, say till 3 or 4 p. m. at which time all the announcements in this particular district may be changed to special doings for the evening or succeeding day merely by throwing an electric switch.

Clean Sewers

"No longer can a municipality afford to overlook the conditions of its sewers," states Frank Gillelen, of the firm of Overbach & Gillelen, sanitary engineers, Los Angeles, Cal. "The water carrying method, by means of closed pipes is undoubtedly most efficient if their pipes are kept properly cleaned so as not to become clogged.

"Usually germs of disease find their way from one patient to another thru excreta. Hence the necessity for extreme care in the disposal of excretions of all kinds. Sewage becomes, then, the possible source of disease and must not be neglected. It is costly to dispose of it properly, but the cost is more than counterbalanced by the easily calculable money value of life and health to many people.

"Sewers should be kept in an unclogged condition at all times. Tree roots, hair pins, sand and grease will create a stoppage and frightful epidemics often result.

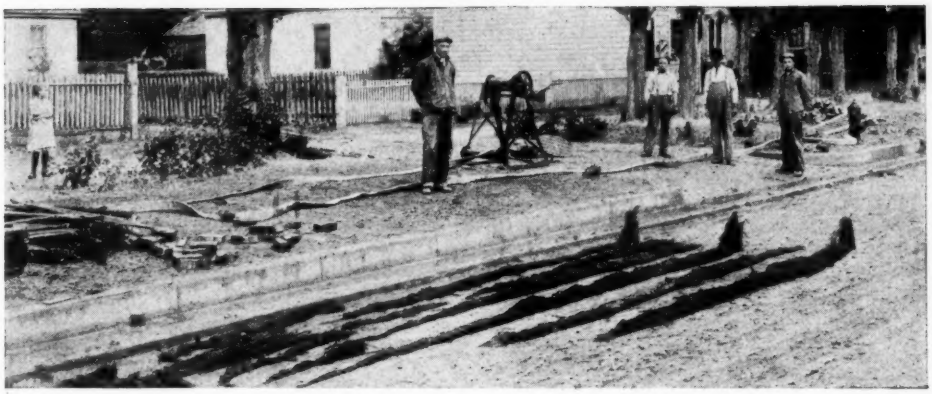
"A machine which will clean sewers of every impediment should be owned by every city or village operating pipe lines for carrying sewage to point of purification or disposal.

"Our attention has been called to the Turbine machine, which is made in Milwaukee, and which has been used with great success in such cities as Sacramento, Cal.; Tulsa, Okla.; Memphis, Tenn.; St. Louis, Mo.; Salt Lake City, Utah; Kansas City, Kans., etc.

"The machine itself consists of a central brass barrel about 25 inches long, with arms carrying four guides, and at the forward end is a miniature hydraulic turbine with three revolving scraper blades. For ordinary work, a rope or cable is passed from one manhole to another by means of quick-coupling sewer rods, the far end of the cable being then attached to a swivel clevis or shackle at the front end of the cleaner. A fire hose, attached to a hydrant, is coupled to the rear of the barrel. Another cable is also connected to the rear of the machine, and this is secured to the hose at intervals, by chain clamps in order to relieve the strain on the hose. Each cable passes over a guide pulley at the bottom of the manhole, and has its upper end wound upon the drum of a compound-geared winch or hand windlass, which is erected over each manhole.

The apparatus being thus connected, the cleaner is entered into the sewer at the upper manhole and the water turned on, while the windlass at the next manhole is operated so as to pull the cleaner through the sewer. With a water pressure of 60 pounds, the turbine is said to develop about 3 horse power. The revolving blades cut and churn all obstructions and with the strong jets of water the material is churned into a grout which flows away in front of the machine to the lower manhole. The machine can be hauled back with the rear cable for a second trip if necessary.

When a sewer is so choked that the pulling cable cannot be passed through by the sewer rods, the cleaner is pushed instead of pulled along the sewer. For this purpose the head rod is attached to the rear end of the cleaner, and a special



ROOTS *of Poplar Trees Removed from Sewer, Salt Lake City, Utah, by Turbine Sewer Renovating Machine.*

worm-gear forcing jack is placed at the bottom of the manhole. This manhole would be at the lower end of the sewer grade. The hose is attached to the barrel as before, and the machine is allowed to work a few minutes to cut and soften the material before being forced ahead.

Efficiency in Fire Apparatus

By E. A. Wilkinson, Gen. Mgr., Nott Fire Engine Co., Minneapolis, Minn.

In the opinion of the writer, the present is not the right time for the manufacturers to comment on the maintenance of motor fire apparatus as against the maintenance of horse-drawn apparatus and if I were to comment on the efficiency of motor fire apparatus I might be misunderstood by some of the readers.

Motor fire engines, which are supplanting the old time-tried steam fire engines, require a good deal of study. The average fire chief today does not go into the matter deep enough because it is too new to him. The average chief has been in the habit when he wanted a steam fire engine for his departemnt of asking his purchasing department to buy a certain size steam fire engine. He knew when he did this that when he bought from any one of the three fire engine apparatus builders he was going to get a good fire engine, but I regret to say that this does not hold with the manufacturers of gasoline fire engines.

We are going through the same experiences today in regard to motor fire apparatus that these companies went through thirty or forty years ago when they adopted the steam fire engine to take the place of the hand pump. In those days nearly every blacksmith shop and machine shop started to build a steam fire engine with the result that after a good deal of experimenting it got down to a specialty of building steam fire engines for the purpose.

We spent four years of the hardest work of our lives designing and perfecting a gasoline pumping engine that would not have to apologize to the efficiency of the steam fire engine, which has been perfected in forty years' work of the best mechanical talent of this country and by large expenditure of money.

Heretofore, it has been the practice of some companies to put engines on the market purely to sell, with absolutely no regard for the future, and if continued it will eventually bring about lost confidence among the fire chiefs in motor fire engines. On the other hand there is not a modern steam fire engine on the market but after three years of service will improve in its efficiency as the newness of the engine is worn out and it becomes free and easy to handle.

This company has given the motor fire apparatus very thorough consideration, and we are looking ahead to the time when every successful manufacturer will have to design his motor fire apparatus for fire department use exclusively, just as was done in the building of the old time-tried steam fire engine.

There is no reason why a gasoline pumping engine should not last from ten to fifteen years and maintain at least 90 to 95 per cent. of its original efficiency, if designed and made for fire department use and properly taken care of by the fire department, when a steam fire engine will last from twenty to thirty years and maintain its efficiency when properly cared for.

The Concrete Sidewalk

By Richard L. Dale, Contractor, Mt. Carroll, Ill.

It is no longer a question of building the concrete sidewalk well enough to keep the pedestrian out of the mud, but of putting down a sidewalk which will last, one which will be a credit to the community on account of its general appearance. Up to the present time, no material has been discovered which can compare in durability, appearance and economy to the sidewalk built of concrete.

In spite of steadily advancing wages and raw materials costs, the municipality is securing better concrete paving, sidewalks and bridges than ever and for less money than was paid ten years ago. Wages and materials show an increase of 35 per cent. during the past ten years. The successful bidder is he who bids lowest and in order to counterbalance increased costs of materials and labor, he has been compelled to take every possible advantage of improved mixing machinery.

We operate the Standard Low Charging Mixers as manufactured by the Standard Scale and Supply Co., in our general concrete construction work as we believe these machines most easily adapt themselves to the many different classes of work in this section. This machine averages one batch per minute and has low charging features which possess many advantages in foundation, bridge, pavement and sidewalk construction. It does not require any elevating loading devices and the consequent saving in mixer is considerable, to say nothing of labor saving effected. These machines are equally suitable for either a dry or wet mix with any material. Our experience has been that more evenly tempered cement mortar can be mixed in the "Standard" than by the hand method and at considerably less cost.

We are keeping an accurate record of different jobs and will supply you with photos and tabulated costs for your subsequent issues.

The semi-automatic discharge feature of our mixer will undoubtedly be of interest to contractors as it is not necessary to employ a special man to operate the discharge door. The barrow-wheeler throws the lever himself. The door is held in either mixing or discharging position by a strong spring under tension and it is only necessary for the operator to throw this door past the center of tension in either direction and the spring will complete the movement and hold the door until it is again thrown by the operator. This door can be thrown open for discharging and left open until the entire batch is discharged or, on the mixers made to discharge about three cubic feet or one wheelbarrow load of concrete per revolution, the door can be closed after a barrow of concrete is discharged and allowed to remain closed until the succeeding barrowman has placed another barrow in receiving position, when the operation is repeated.

Waterproofing Huntington Water Tower

By F. William Stocker, Inc., Waterproofing Engineers and Contractors, New York City.

Following is a brief description of the work performed in connection with waterproofing of water tower at Huntington, L. I.

The water tank is a reinforced concrete structure supported on twelve reinforced concrete columns 40 feet high. The tank is 18 feet high inside, 18 feet wide at the bottom and 26 feet long. The walls are 3 feet thick at the bottom and 1 foot 6 inches at the top. The tank is divided by a 12-inch wall dividing the tower in two sections. This wall has a hole at the bottom so that the water is at the same level in both sections at all times.

The bottom rests on reinforced concrete arches joining the columns and is 2 feet 3 inches thick.

A circular tower adjoins the tank and was cast integral with it.

The following copy of a report prepared by our engineer describes in detail the condition of the tank after its completion.

Engineer's Report on Construction

"I visited the works on the 28th of June, 1912, accompanied by Mr. Stocker, of the Ceresit Waterproofing Company, and beg to report as follows:

"I find that the exterior of the tank walls shows numerous pockets of loose stones barely sticking together by a thin coat of cement and sand. The stones can, however, be easily loosened by a light tapping or even the pressure of the fingers. I personally penetrated the wall to a depth of about 12 inches by tapping the stones with a light ¾-inch bolt. The spot is located below the outside shelf intended to carry the insulating material. Even at that depth there was evidence of honeycomb. This condition is typical of a good many spots on the outside.

The interior of the tank is practically in the same condition. Certain parts have been covered with mortar in an attempt to remedy the defects. This mortar, however, is cracked in few instances due to the richness of the mortar that was used in patching. Large holes have

been dug out showing that the honeycomb is not only on the surface but well into the wall. In the case of the division wall between the two sections of the tank, holes were dug out right through the wall. The reinforcing bars which can be seen where the loose concrete has been removed are not properly surrounded with mortar, a condition which, unless remedied, will impair the strength of the tank. Even behind the smooth part of the wall evidence of honeycomb can be found, indicated by a hollow sound when tapped and also by the fact that a wire could be pushed some distance in small holes in the surface coat of mortar.

Deductions

"The general condition of the concrete indicates that the mixture of cement and sand was of such proportion as to form a good mortar but the amount of mortar was not sufficient to completely surround the stones and make a dense concrete such as would be required for a piece of concrete work intended to hold water.

"It is also evident that the amount of water used in the mixing of the concrete was insufficient as shown by the steep angle of the various strata of concrete and the failure of the concrete to properly surround the reinforcing bars. Owing to the large quantity of steel in these walls, it would have been policy to mix the concrete very wet in order that it might have flowed properly around the bars and in every part of the forms and made a dense wall.

Conclusion

"In view of the above observations, I conclude that the reason of this defective piece of work does not lie with the materials used but in the way they were handled, mainly the improper proportioning of the sand and stone, the use of too little water in the mix and the depositing of too large a quantity of concrete at one place at a time, which could not be spread in the wall and puddled thus allowing the concrete to arch over the reinforcement and form pockets.

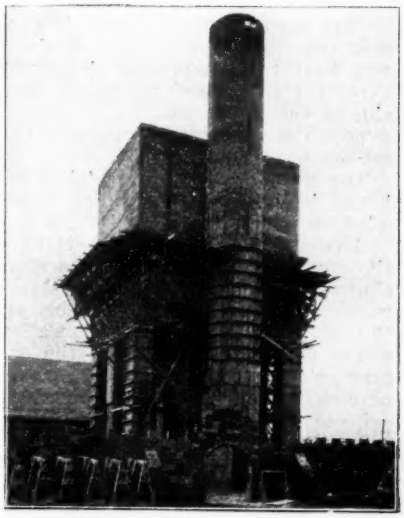
"It will be necessary to remove a thin face mortar off the entire inside of the tank to determine the exact condition of the wall and arrive at a proper solution as to what should be done to make the structure safe and tight."

The tank is supplied by a 6-inch pipe and when water was first pumped into the tank, the water level could not be raised more than 4 inches above the bottom.

Condition Remedied by Waterproofing

The method adopted in waterproofing the structure was as follows:

The entire interior of the tank was picked with hammers to remove the thin coat of cement which faced the wall and expose the concrete. This surface was then thoroughly washed and brushed to remove all loose material. The holes referred to in the report were dug out and all loose stones removed; the larger holes were concreted, wooden forms being used, and the smaller holes grouted with Ceresitized mortar. The entire surface was then lined with ½-inch rods spaced about 18 inches on centers which were wired to the wall reinforcement, the concrete having been removed in sections sufficiently to expose the reinforcing rods. Four-inch expanded metal was then wired to these rods. The walls were then saturated with water and a 1 to 2 omrtar tempered with a 1 to 12 solution of Ceresit was applied to the walls, the mortar being thrown on the wall with a trowel in small quantities. Great care was taken to fill the spaces between the expanded metal and the wall.



HUNTINGTON, L. I. *Water Tower.*

The floor was covered with heavier expanded metal and a 4-inch concrete floor put on top of it. The concrete was mixed in the proportion of 1 part cement, 2 parts sand and 3 parts of ½-inch stone, tempered with Ceresit water.

The expanded metal on the floor and wall was lapped and wired together and the concrete floor was carried up the side walls to form a solid cove around the bottom about 8 inches high.

This floor was trowelled down to a hard surface.

After the first coat of mortar on the walls had set sufficiently, the walls were washed down with a thin grout and a second coat of mortar was applied.

This work was performed in the summer time, and on account of the excessive heat the exterior of the tower was kept wet to reduce the temperature inside of the tank. The cement walls were kept moist to give the concrete the best setting condition.

The second coat was scratched and followed by a third coat which was trowelled to a hard surface.

Between the second and third coats, the tank was filled with water and showed a few leaks on the outside which were traced to a pocket in the soffit of the opening in the center wall. The water penetrated inside of the wall at that point and worked itself through the porous concrete to the outside and dripped in few places; this defect was remedied and the third coat applied. The interior of the tank was kept moist for a period of ten days and a week later the tank was refilled; no sign of water could be seen anywhere.

The total thickness of coating does not exceed 1½ inches and is effectively holding a hydrostatic pressure of 8 lbs. per square inch.

Subsequent examinations of the tank made monthly have so far failed to reveal the slightest leak.

Cleaning Vancouver Streets

By P. Wylie, Supt. of Street Maintenance, Vancouver, B. C.

The equipment of our street cleaning department consists of:

1 Runabout auto for inspection purposes,
56 Horses,
30 Carts.
3 Dump wagons,
2 Pick-up brooms,
5 Single horse brooms,
1 Combination grader,
5 Single horse scrapers,
3 Revolving hand brooms,
3 Pressure flushers,
1 Gasoline pressure flusher,
34 Receiving boxes,
96 Hand carts,
4 Horse brooms,
2 Steel slop carts,
1 Hose truck,
700 feet rubber hose,
2 Sprinklers (2 horse),
200 Waste paper receptacles.

The maintaining of streets in Vancouver in a clean condition is a very hard matter owing to the prevailing conditions, more especially in the business section. There are three existing conditions in this department which cause endless trouble, and to which I would call your especial attention, viz:

The present practice of allowing contractors to carry the earth and mud from the cellars and excavations in the central part of the city. Littering the streets with mud and slush should be prohibited. The practice of allowing contractors to pass over the sidewalks of main thoroughfares where good alleys exist in the rear should be stopped. I would not permit any contractor to come out on a main thoroughfare without a permit from the city engineer, and I feel sure if the city by-law were amended to this extent, the streets would be in a much better shape when the class of work referred to is being carried on.

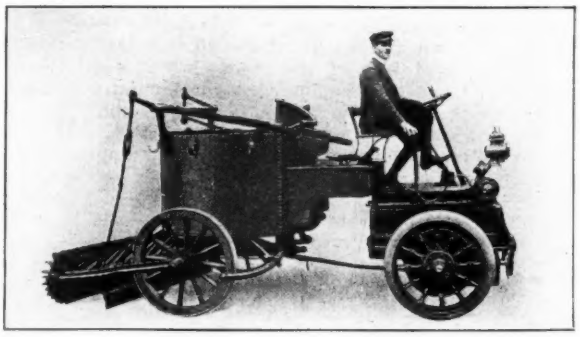
The road oilers and flushers which we operate are made by E. D. Etnyre & Co., Oregon, Illinois.

Elmendorf on Berlin

Milwaukee makes the squeegee street cleaning machines that Berlin uses and to which it owes in part its reputation for being the cleanest city in the world, according to Dwight L. Elmendorf, in his illustrated lecture on Berlin.

"Berlin's streets are literally scrubbed," he said. "You can sit in the shining thoroughfares and not soil your clothing. Between midnight and 6 a. m. great squads of squeegee machines invade the streets and cleaning is done without interfering with traffic."

Mr. Elmendorf contrasted this thorough cleaning process with the usual American method of raking up the dust



ELECTRIC SQUEEGEE, *machine used for washing streets in Paris and Berlin.*

in little piles, which are scattered by the wind, collected again laboriously and spread ad infinitum.

In control of the street car companies, Berlin does things, said Mr. Elmendorf, which would be met with the old American howl that it can't be done, things so radical that public service companies

here would have us put in the insane asylum if suggested to them.

The street car owners, private corporations, are compelled to plant trees along the elevated lines to hide them from public view. Surface roads also must plant flowers and beautify the street at the direction of the city officials, wherever it is possible. The surface cars are small, noiseless and run frequently. Certain cars permit an exact number of standing passengers for a reduced fare. There is no crowding of cars, said Mr. Elmendorf.

The illustration herewith represents an electric-driven squeegee machine as used in Berlin and Paris and described in the lectures of Dwight L. Elmendorf. The machine is made for this country by the Kindling Machinery Co., Milwaukee, Wis.

The Light Motor Truck

That public utility companies and various municipalities are gradually replacing their light horse-drawn trucks by light motor trucks is demonstrated by the increasing number of trucks seen on the streets of any city, large or small.

The advantages of motor trucks over horse-drawn vehicles have been demonstrated so thoroly that it will not be long until public utility companies will find it absolutely necessary to use these vehicles. Modern business methods demand quick transportation. Hence the motor truck assists the corporation in the matter of developing its business facility for delivering. The motor truck can be applied to any kind of business. The small, light motor truck is especially adapted for different municipal departments. A great deal of the work on the state highways is being done by motor trucks, the contractors finding that they can haul material for the construction work to all sections of the road with greater speed, and at less cost than can be done by horse-drawn vehicles.

Performance proves that the motor truck is not subject to the elements, extreme heat or cold, and this is one of the big reasons for its growing popularity. The Peoples Gas, Light & Coke Co., and The Chicago Telephone Co. operate several serverciable Mercury trucks of 1,000 pounds capacity and at a great saving over an equal number of horse-drawn wagons. The average load carried on a 2,000-pound truck does not exceed 600 pounds, except in cases where large single pieces are hauled. At a less initial cost, two 1,000-pound trucks can be had and will do the work at all times; one of them most of the time, because it is lighter and faster, while the other is there for emergency.

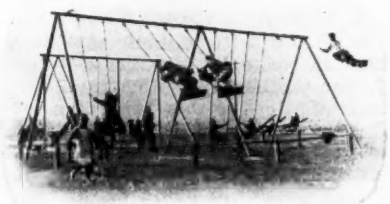
If but one 2,000-pound truck is used, and that is out of order, the work is not done. With two 1,000-pound trucks the load may always be carried without question. One can be operated at about half the expense of a one-ton truck, including the driver. Of course, this would not apply in all cases, but when the load does not consist of single pieces weighing from 1,000 to 2,000 pounds, it does apply and the statements above are absolutely correct in every particular. The saving in tires, gasoline, oil and time is wonderful.

Rockford Playgrounds Popular

By Paul B. Reis, Supt. Board of Park Commissioners, Rockford, Ill.

We are giving especial attention to the development of playground features thruout our park system. It is our intention to have more playground festivals and outdoor performances of the character of those held in Chicago playgrounds to be given by the children of the public schools during the coming summer.

The park board hopes to acquire other tracts of land for playground purposes in parts of the city which are not yet served with park privileges. The members of the board have in mind several tracts,



GALVANIZED SWINGS *are used in Rockford playgrounds, made by Fred Medart Mfg. Co., St. Louis, Mo.*

some of which will be undoubtedly acquired during the coming season.

The park board decided that Rockford parks ought to be places where all the children of the city might go and play and have the benefit of the beautiful shade trees, the grass and the flowers. A place much safer, cleaner and better in every way than the railroad yard, the alleys and the streets. The parks are now the big yards for all the children to play in. Many poor children have to be taught to play. The simple, healthy, wholesome games they know nothing about; the seesaw, "London Bridge is Falling Down," or "Ring Around the Rosy."

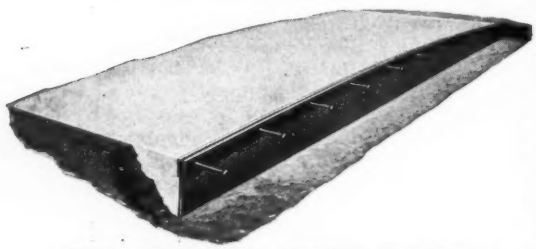
With all this in mind the park board has changed four of the large parks into public play grounds. There are swings, see-saws, rings, trapezes, sand piles and wading pools for the children. There are baseball diamonds for large and small, tennis courts, and cricket grounds, and in one park as fine a third of a mile cinder track as can be found in the state.

At present, we have installed combination athletic frames, consisting of flying trapeze, flying rings, horizontal bars, sliding poles and shutes. We also have a set of swings for girls and boys and small children, teeters and teeter ladders, flying Dutchmen, giant strides, small chutes for children, and merry-go rounds. We find the most popular pieces in use are the merry-go rounds for the small children, and the teeters and swings for the larger folks. We also have parallel bars and vaulting horses and find the athletic frames much used by the young men. Tennis and base ball, of course, are very popular, and it is very hard to furnish enough courts and diamonds to accommodate all players; but we are fortunate in being able to supply enough for the present time. and are in position to add to these in the future. Our outdoor basket ball court has taken tremendously well.

Trus-Con Armor Plate

We are illustrating herewith two armor plates in blades with ¼-inch asphaltum felt filler as made by the Trussed Concrete Mixer Co., Detroit, Michigan.

The installation of this type of armor plate is accomplished by clamping the two bars together with a layer of asphaltum felt of desired thickness between, the felt cutting the entire depth of the pavement. Or of preferred, a steel plate is placed temporarily between the two armor plates and is removed after concrete is poured, the space then being filled with plastic asphaltum. Either process is satisfactory, will allow of expansion and will prevent joint filling with grit; although felt method is somewhat cheaper. The assembled plates are held in place at exact grade line by being attached temporarily to side grade boards and supported by pins driven into subgrade.



TWO TRUS-CON ARMOR PLATES *in place, protecting the joint with ¼-inch asphaltum felt for filler, cutting entire depth of pavement.*

This steel plate is said to protect and insure even gradual wear of the so-called weakest part of the concrete pavement. It is said to be thick enough, deep enough and hard enough to protect the edge against which it is placed for a period of the entire life of the pavement.

Fuel Saving and Smoke Prevention Thru the Use of a Smokeless Firebox Boiler

By Robert W. Hunt & Company, Engineers, Chicago.

The question of smoke prevention is one being largely discussed at the present time. Many of our American cities have awakened to the fact that smoke is absolutely harmful to the health of their inhabitants in addition to rendering almost impossible the beautification of a city, not to speak of the extra tax imposed on the citizens through the increase in cost of clean linen, clean homes, all so necessary to good health and civic pride.

Quite naturally the first "smokeless" agitation raised a storm of protest from the owners of smoking stacks. It was argued that were a smoke ordinance enacted it would compel the use of anthracite or Pocahontas coal (both expensive), or the installation of costly smoke prevention devices.

However, experience has shown that the commercial smokeless boiler of today (and there are several good makes on the market), is not only fully sufficient in smoke-prevention ability to meet the most stringent smoke ordinance; but also is so much more economical in the use of coal, and permits the use of much cheaper coal, that the coal saving effected by such a boiler quickly repays the cost of the installation and actually earns profit for the owner through the coal saving it effects.

That the above statements are true is proven by tests made by us, both regular and smokeless firebox boilers being used. These tests were made at Kewanee, Illinois, using a Kewanee firebox boiler No. 12 (designated Boiler No. 2 in following tests), and a Kewanee smokeless firebox boiler No. 11 (designated as No. 1 in following tests).

The efficiency of these boilers, as shown by these tests, shows a remarkable saving when the smokeless type of boiler is used. Note that with boiler No. 1 (the

Kewanee smokeless boiler), the efficiency ranges from 47.1 per cent to 74.9 per cent. as against efficiency of 39.5 per cent. to 65.2 per cent. shown by boiler No. 2.

Comparing the different tests in which different coal was used, shows the following:

The figures relative to the density of the smoke emitted from the stack during these tests are also most interesting.

By average density is meant the percentage of time that black smoke would need be emitted to equal the smoke actually observed. According to these tests it can very safely be stated that the boilers used are well within the requirements of the strictest smoke ordinance yet passed or likely to be passed.

With Iowa slack.....Smokeless 47.1 per cent., Regular 39.5 per cent. efficiency
Iowa slack .....Smokeless 57.9 per cent., Regular 43.3 per cent. efficiency
Illinois mine run .....Smokeless 59.3 per cent., Regular 48.5 per cent. efficiency
Illinois nut .....Smokeless 67.0 per cent., Regular 56.1 per cent. efficiency
Illinois lump .....Smokeless 74.3 per cent., Regular 65.2 per cent. efficiency
Pocahontas .....Smokeless 74.9 per cent., Regular 57.2 per cent. efficiency

Commercially speaking, a boiler of 75 per cent. efficiency, that is a boiler that will utilize 75 per cent. of the heat units in the coal, is perfect.

And as the efficiency of the majority of boilers ranges from 51.70 per cent with Illinois lump coal to 57.42 per cent. with Pocahontas (as shown by tests made at the University of Illinois Engineering Experiment Station, their bulletin (No. 51), the value of the use of a smokeless boiler is conclusively demonstrated.

We present these figures as an aid to anyone who is giving consideration to the smoke nuisance.

And our experience shows us first, that smokeless boilers can be and are being manufactured; and second, that the use of such a type of boiler means decreased coal bills.

BOILER NUMBER 1. (No. 11 KEWANEE SMOKELESS BOILER.)

Test number	1	2	3	4	5	6
Duration of trial, hrs...	10.00	10.10	9.37	11.95	10.10	9.31
Pressures—						
Barometric, inches	29.450	29.250	28.81	28.98	29.070	29.290
Steam (cor'ct. gage), lbs.	5.150	5.400	4.32	3.10	4.420	5.000
Draft, inches	.243	.228	.18	.21	.235	.216
Temperatures, Deg. F.—						
Boiler room	73	73.5	79.2	79.4	63	72.2
Flue gases, stack.....	337	296.0	256.0	286.0	280.0	343.0
Gases, rear of setting....			588.0	591.0	636.0	637.0
Feed, water	70	66.7	72.7	174.0	175	175.0
Kind of Fuel—	Iowa Slack	Illinois Lump	Illinois Nut	Iowa Slack	Illinois Mine Run	Pocahontas
Proximate Analysis—						
Moisture, per cent.....	11.93	7.84	4.62	8.42	5.26	.54
Volatile matter, per cent..	28.06	34.08	32.00	30.80	32.40	15.26
Fixed carbon, per cent...	28.60	42.84	52.02	32.02	48.12	74.36
Ash, per cent.....	31.41	15.24	11.36	28.76	14.22	9.84
B. t. u., per lb. as fired..7691.00		10944.00	12190.00	8806.00	11609.00	14153.00
Total fuel, lbs.....2128.00		1561.50	1236.00	2546.00	1538.00	964.00
Dry coal, lbs.....1874.00		1439.00	1179.00	2319.00	1457.00	958.80
Total ash, lbs.....	587.00	214.00	149.50	786.00	241.00	81.00
Comb'ble in ash, per cent.	23.01	31.65	28.70	27.00	15.67	48.23
Fuel per Square Foot Uppergrate, per Hour—						
As fired, lbs.....	16.25	11.80	16.08	16.26	11.62	7.90
Dry, lbs.....	14.30	10.87	9.60	14.80	11.02	7.86
Combustible, lbs.....	9.82	9.35	8.32	9.79	9.19	7.20
Evaporation, Feed Water—						
Per lb., coal as fired, lbs..	3.98	7.27	7.63	4.52	7.15	10.80
Per lb., dry coal, lbs.....	4.52	7.88	8.00	4.96	7.55	10.99
Apparent Dry Steam—						
Per lb., coal as fired, lbs..			7.36	4.08	6.81	10.48
Per lb., dry coal, lbs.....			7.71	4.48	7.14	10.52
Apparent Dry Steam From and at 212 Degrees—						
Per lb., coal as fired, lbs..	4.58	8.39	8.43	4.27	7.10	10.92
Per lb., dry coal, lbs.....	5.20	9.09	8.83	4.69	7.49	10.98
Per sq. ft. h't'ng sur., lbs.	2.00	2.65	2.23	1.86	2.22	2.32

Efficiency Apparent—						
Boiler and grate over all, per cent	57.90	74.30	67.00	47.10	59.30	74.90
Gas Analysis—						
CO_2, per cent	4.90	4.30	6.42	4.90	5.08	5.26
Density of Smoke, Per Cent. of Time—						
No. 0 Smoke	63.40	39.40	52.40	27.50	44.10	86.00
No. 1 Smoke	27.10	45.40	22.90	62.50	28.60	13.20
No. 2 Smoke	8.70	13.30	18.70	9.80	20.70	0.00
No. 3 Smoke	0.70	1.80	5.70	1.20	6.30	0.80
No. 4 Smoke	0.10	0.10	0.30	0.00	0.30	0.00
No. 5 Smoke	0.00	0.00	0.00	0.00	0.00	0.00
Average density, per cent.	.05	.15	.21	.16	.27	.03

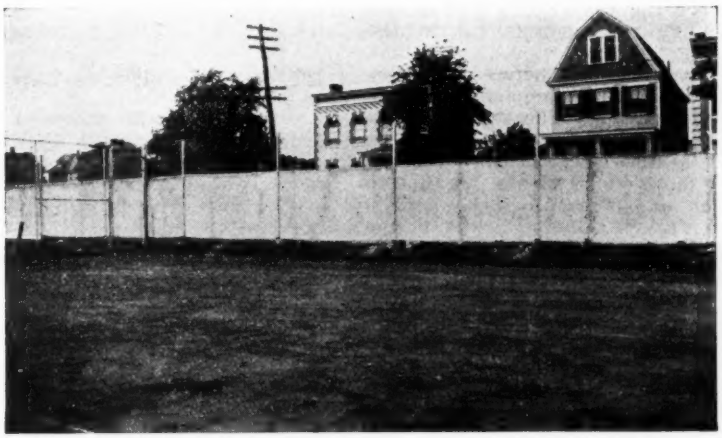
BOILER NO.2. (SIZE NO. 12 KEWANEE REGULAR FIREBOX BOILER.)

Test number	7	8	9	10	11	12
Duration of trial, hrs	10.10	9.83	9.72	11.37	10.05	9.82
Pressure—						
Barometric, inches	29.450	29.250	28.810	28.980	29.070	29.290
Steam (cor'ct. gage), lbs.	6.600	7.570	5.730	3.160	3.540	3.850
Draft, inches	.204	.207	.195	.216	.238	.232
Temperatures, Deg. F.—						
Boiler room	73.0	73.5	79.2	79.4	63	72.2
Flue gases, stack	285.0	273.0	311.0	283.0	303	307.0
Gases, rear setting			628.0	637.0	631	597.0
Feed, water	70.1	67.2	72.3	171.0	174	176.0
Kind of Fuel—						
Proximate Analysis—	Iowa Slack	Illinois Lump	Illinois Nut	Iowa Slack	Illinois Mine Run	Pocahontas
Moisture, per cent	11.93	7.84	4.62	8.42	5.26	.54
Volatile matter, per cent.	28.06	34.08	32.00	30.80	32.40	15.26
Fixed carbon, per cent.	28.60	42.84	52.02	32.02	48.12	74.36
Ash, per cent	31.41	15.24	11.36	28.76	14.22	9.84
B. t. u., per lb. as fired	7691.00	10944.00	12190.00	8806.00	11609.00	14153.00
Total fuel, lbs	1693.00	1317.00	1188.50	2030.50	1295.00	846.00
Dry coal, lbs	1491.00	1214.00	1133.70	1859.50	1226.80	841.40
Total ash, lbs	566.00	179.00	196.50	619.00	228.50	68.00
Total ash, per cent	33.40	13.60	16.53	30.50	17.65	8.04
Comb'ble in ash, per cent.	33.00	33.00	36.50	18.14	25.06	32.70
Fuel Per Square Foot Grate, per Hour—						
As fired, lbs	10.28	8.22	7.51	10.95	7.90	5.28
Dry, lbs	9.06	7.58	7.16	10.03	7.52	5.26
Combustible, lbs	5.62	6.46	5.91	6.69	6.12	4.83
Evaporation, Feed Water—						
Per lb., coal as fired, lbs.	3.04	6.37	6.55	4.40	6.69	9.61
Per lb., dry coal, lbs	3.46	6.90	6.87	4.81	7.08	9.66
Apparent Dry Steam—						
Per lb., coal as fired, lbs.			5.48	3.44	5.56	8.03
Per lb., dry coal lbs			5.74	3.75	5.88	8.08
Apparent Dry Steam From and at 212 Degrees—						
Per lb., coal as fired, lbs.	3.51	7.36	6.31	3.59	5.80	8.34
Per lb., dry coal, lbs	3.99	7.97	6.60	3.93	6.12	8.39
Per sq. ft. h't'ng sur., lbs.	1.17	1.96	1.53	1.28	1.49	1.43
Efficiency Apparent—						
Boiler and grate over all, per cent	43.3	65.2	56.1	39.5	48.5	57.2
Gas Analysis—						
CO_2, per cent	3.00	5.5	4.5	5.22	4.37	4.4
Density of Smoke, Per Cent. of Time—						
No. 0 Smoke	2.10	0.50	8.80	5.40	0.00	76.00
No. 1 Smoke	51.30	54.80	54.10	40.70	44.00	16.40
No. 2 Smoke	36.30	33.40	29.40	33.10	38.50	6.10
No. 3 Smoke	9.30	8.40	5.40	14.80	14.20	0.50
No. 4 Smoke	0.80	2.60	2.30	1.00	3.30	0.00
No. 5 Smoke	0.20	0.30	0.00	0.00	0.00	0.00
Average density, per cent	.31	.32	.27	.33	.35	0.60

A Good Cheap Concrete Fence

A concrete fence which should prove of interest to our readers was recently designed by R. V. Moss, city surveyor of New York city, for the Glen Ridge tennis courts. It is strong and durable, of neat appearance, and can be quickly erected at low cost.

At 12-ft. 1-in. centers 3-in. I-beams 12 ft. 6 in. in length were sunk in the ground to a depth of 2 ft. 6 in., leaving 10 ft. of post above the surface. The flanges of these beams were wrapped with expanded metal lath to a height of 6 ft. above grade to carry cement plaster. A 2 by 3-in. spruce bottom rail was placed between the posts along the ground and a top rail of the same size at a height of 6 ft., with Rib-Trus reinforcing plates, manufactured by the Berger Mfg. Co., Canton, Ohio., extended to cover the space between. The concrete was then applied on the reinforcing plates to a thickness of 3 ins.



A FENCE *of concrete and wire of good design.*

Above the reinforced concrete portion of the fence, wire netting is fastened to the height of 4 ft., making the entire height of the fence 10 ft., 6 ft. of which is concrete and the remainder wire.

The cost of this type of fence is extremely low, especially for the concrete portion of it, which, in this case, is increased by the fact that the I-beam posts extend 4 ft. above the concrete to carry the netting.

The concrete portion alone cost about 25 or 30 cents per sq. ft., including the contractor's profit, which made the cost of the 6-ft. fence from $1.50 to $1.80 per lineal ft. The average fence costs from $2.00 to $2.50 per foot, is neither as easily nor as quickly erected, and is seldom as strong and durable.

Machinery in Highway Construction

By A. N. Johnson, State Highway Engineer of Illinois.

Experience in Illinois shows that hauling with a tractor outfit is cheaper than team hauling for the same distances, and that the economy increases with the length of the haul up to the maximum for which data have been obtained in the work of the commission. The cost per cubic yard for hauling crushed stone with the tractor outfit is about 60 per cent. that of team hauling for one mile and about 40 per cent. of the cost of team hauling for distances of three miles. This cost includes the pay of the operator for the engine, who is paid straight time regardless of the conditions of the weather and whether the job is running or not, the cost of the fireman who is paid only for the days when the outfit works, the cost of fuel, oil and supplies for the steam engine, and the cost of maintenance.

During the average season in Illinois from May 1st to December 1st, a tractor outfit can be used for hauling over earth roads only about 50 per cent. of the time. A hauling outfit costs approximately $4,000, and in the work of the commission, the cost of maintenance has been $100 per season.

The construction of concrete roads requires a complete outfit of machinery. A steam or gasoline roller weighing about ten tons will be required, and in addition there will be certain special machinery for handling the concrete.

The mixer should be a batch mixer and should load from in front and discharge

from the rear. The mixer should be self-propelled and for this class of work experience shows that the steam-driven machine is more satisfactory than the gasoline-driven.

In country road work it will also be found that the water supply system will require special attention. The water will be obtained from ponds, reservoirs or from wells, and must be pumped to the mixer. This will necessitate a pumping outfit and a system of piping arranged alongside the road so that the hose from the mixer can be attached at any place. The pumping outfit should be of ample capacity, certainly capable of delivering three or four times the amount ordinarily required by the mixer itself, because in hot weather a large amount of water is necessary for wetting down the subgrade before the concrete is placed and for sprinkling the concrete behind the mixer.

In addition to the concrete apparatus there will be required templets for striking the road surface. These usually consist of two boards 1 inch or 1¼ inches thick, cut to the desired crown for the road and fastened to blocks parallel to each other and about 6 inches apart. They are drawn along the top of the forms at the edge of the concrete. For floating the surface after it has been struck off to the desired crown, a float made of a thin board of sufficient length to reach the entire width of the pavement being constructed and 1 foot on each side is bent to the crown of the finished pavement and held by means of ribs to which it is attached. This float is drawn with a combined forward and crosswise movement in such a way as to float the finished concrete and at the same time strike it down to the desired shape.

There will also be required with the concrete outfit the ordinary tools used in concrete work, that is, wheelbarrows, shovels, picks, tampers and similar tools. The cost of a complete concrete road outfit can be made anything desired, but the essentials for placing the concrete and furnishing the water supply, including a mixer having a capacity of about 1,000 square yards of 6-inch pavement per day with all auxiliary apparatus and tools, will cost about $2,700.

We use Koehring street paving mixer very extensively in our work and this machine very readily averages from 600 to 800 square yards of 7-inch concrete for a 9-hour-day. This average, however, has been made with a gang of men that could not be called well trained.

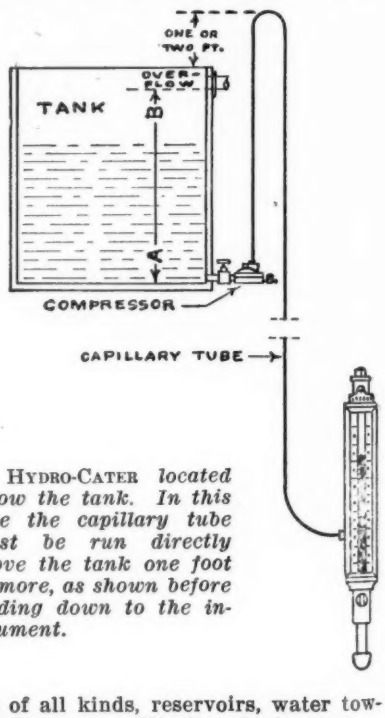
Our Koehring mixer has a rated capacity of about 14 cubic feet to one batch of material.

I believe a well-trained gang should make an average of 800 to 900 square yards. The gang consists of one man running the hoisting apparatus on the mixer, one man running the delivery bucket, ten men shoveling into the mixer, working in relays of five each, two men on forms, two men finishing, one man spreading canvas and keeping same moist and moistening the work already done, and one superintendent.

It is to be understood that the road bed has been previously shaped and the gravel and sand hauled on the work and the cement delivered. With the exception of the cement delivered, this work may be all done before the mixer arrives. The delivery of the cement will require two or more teams, depending upon the distance to be hauled, and requires one man opening the sacks and dumping same into the mixer.

The Hydro-Cater

A new hydraulic indicator called the Hydro-Cater is herewith shown. This instrument is for indicating the depth of water or other liquids, and can be located any distance above, below, or from, the liquid to be indicated. It is adapted for



THE HYDRO-CATER *located below the tank. In this case the capillary tube must be run directly above the tank one foot or more, as shown before leading down to the instrument.*

tanks of all kinds, reservoirs, water towers, wells, pumps, filtering plants, etc.

The instrument itself is very simple, being free from any mechanism or moving parts. It shows, at all times, the

exact amount of water in the tanks or water towers in feet and inches or gallons.

The contents of the tank are shown by a brilliant red liquid or mercury, in a glass tube; the scale reading is ten inches high for the standard instrument, which represents the full depth of tank, whether it is 2 feet or 100 feet, as each gage is especially calibrated for the depth of tank and the specific gravity of the liquid to be indicated. The manufacturers make them up with longer glasses, up to 72-inch readings, if desired.

The instrument is fastened to the wall of an office, and an ⅛-inch outside diameter capillary copper tube, annealed, and very flexible, is run to the tank like an electric wire. It may be run above or below the ground; it contains only air and cannot freeze or stop up. One end of this hollow wire is attached to the top of a casting 6 inches in diameter, which is called the compressor, and is attached to the bottom and outside of tank as shown, or may be simply lowered thru the top, to the bottom on the inside.

The static pressure of the liquid in the tank forces the trapped air in the compressor and tube line against the indicating liquid in the instrument, and causes it to rise in the glass tube in exact proportion to that in the tank.

They serve as well to indicate the rise and fall of water in rivers, dams, and flumes, and are made for registering oils, gasoline, syrups, spirits and chemicals. They are specified and used by the United States Navy, and are manufactured by the Sterling Gauge Co., 132 Larned St., East, Detroit, Mich.

Reading, Pa., Water Works Improvements

The improvements recently made to the municipally owned water works of the city of Reading, Pa., consist of the building of two slow sand filtering plants and the covering of two distributing reservoirs.

The Penn street reservoirs, consisting of two basins having a combined capacity of 5,647,000 gallons, were covered with groined concrete arches supported upon concrete pillars. The arches are semi-circular in section, have no reinforcing metal imbedded and are six inches in thickness at the crown. To carry the unbalanced thrusts occasioned by live loads over one-half of the arches, concrete struts were introduced from pillar to pillar, and then to the end walls, which in turn are supported by the earth backing. The groined arches are covered with 18 inches of boiler cinders supporting a 6-inch concrete floor, used for roller skating and playground purposes in summer time, and for ice skating in the winter.

FOUNDATION AND COLUMNS *ready for Arches.*

The other (Buttonwood street) reservoir, situated on the slope of Mount Penn, was covered with reinforced concrete floor slabs supported by reinforced concrete beams and girders on columns. The reservoir was also relined to make it water-tight. It holds 926,000 gallons of water.

Both reservoirs were covered to prevent the growth of algae in the filtered water stored therein, and to prevent polluting matter from being blown or thrown into the water.

Eight thousand five hundred and forty-two and one-fourth barrels of Lehigh Portland cement were used in the improvements to the Penn street reservoir and one thousand and thirty-six barrels in the Buttonwood street reservoir. Fehr & O'Rourke, contractors of Reading, Pa., did the work on both reservoirs.

The slow sand filters for the Bernhart supply consist of six filtering beds 71x138.5 feet each. The capacity of each bed is three-quarters of a million gallons per day.

The filters are built upon clay soil, with a 5-inch concrete slab bottom, concrete piers and concrete groined arches. The arches are covered with 2 feet of soil and sodded. Eight thousand, five hundred and thirteen barrels of Lehigh Portland cement were used in the construction of these filters. Albrecht & Leader, of Reading, Pa., were the contractors for this work.

Paving in Springfield, Mo.

By C. E. Phillips, City Engineer.

During the year 1912 we constructed five different kinds of pavements but from experience we have had to date it is our belief that Sarcolithic Mineral Rubber pavements will be more satisfactory in the long run as this pavement seems to be the most highly developed and satisfactory form of asphalt pavement for general purposes. It is exceedingly tough and rubbery and when properly laid shows little sign of wear even after a very lengthy period. Our experience has been that it withstands diverse traffic conditions and is least effected by temperature ranges. It has a dark appearance and is practically noiseless and dustless. The surface while smooth is more gritty than most asphalt pavements as a larger stone is used in its wearing surface and consequently is less liable to prove slippery. During the year 1912 the Jarrett-Richardson Paving Co. laid the following Sarcolithic Mineral Rubber pavements in this city, in all of which pavements Sarco asphalt was used:

Street and Distance	Kind	Width Paved	Lin. Ft.	Sq. Yds.
Harrison, Jefferson to Mrytle	Asphaltic Concrete	27 feet	1803.45	5052.00
Jefferson, Elm to Madison	Sarco	36 feet	1840.00	7496.76
O'Fallin, Market to Main	Asphaltic Concrete	18 feet	374.40	736.40
Main, Mt. Vernon to Philips	Asphaltic Concrete	24 feet	1249.10	3316.12
Myrtle, Cherry to Monroe	Asphaltic Concrete	24 feet	896.50	2443.13
Grant, Commercial to Atlantic	Asphaltic Concrete	40 feet	1334.60	4116.63
Main, Phelps Ave. to Nichols St	Sarco	36 feet	2344.40	6868.01
Walnut, Jefferson to National Blvd	Sarco	36 feet	4067.70	16371.10
Cherry, Jefferson to Dollison	Sarco	36 feet	2225.60	8994.13
Cherry, Dollison to National Blvd	Sarco	28 feet	1750.40	5509.59
Market, Walnut to Phillips	Asphaltic Concrete	30 feet	2281.40	6710.70
Fremont, Cherry to Catalpa	Asphaltic Concrete	24 feet	3936.80	9635.51
Lombard, Holland to Kings Highway	Asphaltic Concrete	24 feet	1337.70	3445.72
Belmont, Holland to Kings Highway	Asphaltic Concrete	24 feet	1337.70	3628.63
Main, Walnut St. to Mt. Vernon	Asphaltic Concrete	36 feet	1053.00	3895.66

During the year 1912 we laid 45,000 square yards of the Sarcolithic Mineral Rubber pavements in the city of Springfield, Mo., as well as considerable of this same type of pavement prior to above year. Pavements which have been down for a period of two years show no signs of wear whatever. Sarcolithic Mineral Rubber pavements are extremely popular in this community as the larger stone which is used in their wearing surface give it more body than asphaltic concrete. Our experience has been that it lasts longer and does not crack up in hot weather. Its gritty surface makes it the most reliable and safest for the travel of horses and autos.

WALNUT STREET, *Springfield, Mo., paved with Sarcolithic Mineral Rubber.*

The Friend Power Spraying Outfit

The Friend Mfg. Co., of Gasport, N. Y., claims the distinction of building the first gasoline power sprayer in 1901. The business has developed into one covering the whole world.

A sprayer outfit includes a supply tank, which may be of any transportable size but practically should be about 200 gallons capacity. There must be a mechanical agitation in the solution tank running smoothly and all the time. There must be pressure to force the solution out thru the special nozzles which distribute it over the foliage. These necessitate a truck, a tank, a gasoline engine,

Dudley Avenue, Westfield, N. J.

A Tarvia Town

THERE are many towns in this country which began with Tarvia years ago and finding it successful have extended its use on their roadways year by year as a matter of fixed policy. Such a town is Westfield, N. J., which now has 19 miles of tarviated streets.

Mr. A. W. Vars, the town engineer, reports that the "Tarvia B" treatment on all these streets averaged 1¾c. per square yard for the season of 1912; compared with the cost of keeping down the dust and maintaining the road surface by any other method, this is a very low figure.

The roads have been free from dust and have not been seriously impaired by automobile traffic.

Tarvia acts as a binder and cements the road surface firmly together in a plastic matrix. Automobiles do not hurt such a surface but roll it down smoother.

The amount of new stone screenings needed for surface maintenance is greatly reduced by the Tarvia treatment and the road keeps in better condition. The longer the Tarvia treatment is maintained, the less the annual cost.

Booklets on request.

BARRETT MANUFACTURING COMPANY

New York Chicago Philadelphia Boston St. Louis Kansas City Cleveland Cincinnati Minneapolis Pittsburgh Seattle Corey, Ala.

The Paterson Mfg. Co., Ltd.—Montreal, Toronto, Winnipeg, Vancouver. St. John, Halifax, Sydney, N. S.

hose, nozzles, ladder or elevated platform and various valves and automatic appliances.

The Friend Mfg. Co. supply outfits of various capacities and capabilities, such as the new Western Friend with 250 gallon tank; the orchard model, 200 gallons capacity; the hilly orchard model with low tank so that it will not overturn; still smaller models for one horse; the high pressure park sprayer for shade trees with low hung tanks of 200 gallons capacity, high pressure pump and hose, long spray poles, etc. Hand outfits for wagon or cart are also supplied, as well as any of the separate parts.

The company will supply any desired detail regarding their outfits on request. They are specially applicable to street and other city trees as well as to park and orchard trees.

Protecting Trees From Insect Pests

A booklet has come to hand recently which gives full information about methods of protection of trees and shrubs from their insect enemies, which will be of great value to park and tree conservers as well as to orchardists.

It contains a spraying calendar which gives the time for spraying with each kind of insecticide required for the pests which appear for each of some twenty kinds of trees, bushes and vegetables, and the materials and methods of the various insecticides and fungicides.

The apparatus used for spraying is also fully described and illustrated, showing hand and power sprayers of many different designs and capacities for every sort of duty required.

Another good book is entitled "Spraying for Profit," and answers any probable question as to materials, methods and results.

These books are published by the Deming Co., Salem, O., and will be supplied on request.

They supply also all sorts of hand and small power pumps and force pumps, air compressors and hydraulic rams and the Deming hydro-pneumatic system of water supply for furnishing water under pressure to single houses and their service buildings.

Full information will be supplied by the company on request.

Trade Notes

The mayor of a small Iowa city is asking for applications for position as manager and superintendent of an electric lighting plant, at $85 to $100 a month. Letters to this office will be forwarded to him.

The Electric Railway Equipment Co. have removed their New York office to the Hudson Terminal building, 30 Church street.

The F. A. Pease Engineering Co., civil and consulting engineers, have moved their offices to the Marshall building, Cleveland, O.

J. F. Druar, consulting engineer, The Oscar Claussen Engineering Co., St. Paul, Minn., has been retained to draw plans and specifications for the municipal waterworks system of Maple Lake, Minn., the work to consist of water mains, valves, hydrants and 50,000-gallon tank on a 115-foot tower. Notice of date of letting later. Plans and specifications were ready April 15, check for $2.50 to cover cost of reproduction. Plans and specifications for a municipal electric light plant for Mayville, N. D., are just ready.

The Sefton Manufacturing Company, Chicago, has awarded a contract to the Raymond Concrete Pile Company, New York and Chicago, for constructing a 600-foot reinforced concrete bulkhead dock at their plant on the south branch of the Chicago river, Chicago. George R. Morris, architect, Baltimore, Md., has awarded them contract for placing standard Raymond concrete piles and footings for the Avon apartment house, and Buffalo has let them contract for 600 piles for foundation of Venturi meter and valve house at Porter avenue pumping station, and for foundation of Hutchinson high school.

The Merritt Hydraulics Co., 1211 Fidelity building, Philadelphia, Pa., have purchased the business of the hydraulics department of Merritt & Co., of Camden, N. J., and now make and sell the Merritt, Weand and Priestman sewage siphons, flush tanks, sprinkler nozzles, automatic lifts and screens, pneumatic ejectors and other sewage disposal apparatus.

William F. Morse, 90 West street, New York City, notifies the trade that he has no interest in the Atkinson-Morse Destructor Co., of New York, and is not responsible in any way for its debts, contracts or obligations of any nature, and that that company has no right to the use of his designs or patents, or the use of his name in connection with the sale of rights to build or contracts for the construction of garbage destructors or incinerators.

Trade Publications

Stone and Webster, electric railway and lighting properties for 1913. Leather, 75 pp.

J. W. Howard, consulting engineer on roads, streets and pavements, 1 Broadway, N. Y., issues a number of very helpful circulars on specifications, tests and

Placing Baker Armored Joint on Smith Avenue, Hamtramck, Michigan.

BAKER ARMORED CONCRETE PAVEMENT

(Patent Applied For)

IS THE MOST DURABLE PAVEMENT KNOWN

BAKER ARMOR PLATE

—insures true and even joints absolutely flush with the balance of pavement. No ruts or depressions at this point.

—rolled into shape to fit standard curves of street pavements. Special curves rolled to order.

Our improved labor saving methods are protected by patents applied for, but we have no desire to restrict their use by those purchasing our Armor Plates, and we welcome any requests for information that may enable the contractor to produce better results, or perform his work in a more economical manner.

1,249,678 Square Yards

NOW IN USE IN FIFTY CITIES. SEND FOR THE LIST.

Illustrated Particulars, including specifications, on request.

THE R. D. BAKER COMPANY

DETROIT, MICHIGAN.

ME

inspection for brick, asphalt, and wooden block streets and on census of traffic on streets and roads.

Crane-ing is a lively little monthly distributed to advertise the Cleveland Crane & Engineering Co., Wickliffe, O.

A recent circular of the Kewanee Boiler Co., Kewanee, Ill., gives a list of modern school buildings in which their fire-box boilers have been installed by the Bryce Heating & Ventilating Co., in Michigan, Ontario, Indiana and Ohio and pictures of a dozen of them.

The Andrews Heating Co., Minneapolis, Minn., have in their catalog a steel septic tank for use of private houses, which may be placed in the basement or buried in the ground and discharge into stream or filter or underground gravel bed.

The American Asphaltum and Rubber Co., Chicago, Ill., calls attention in a circular letter to their intention to appeal from the decision of Judge Kohlsaat against them in the claim of their infringement of the Culmer patents and that a heavy bond is not required in connection therewith.

The Gier & Dail Mfg. Co., Lansing, Mich., distribute a handsome advertisement of their sanitary drinking fountains, which are unique as the bubbler is movable and as convenient to use as a cup.

Barrett specification roofs are the standard, because they are so thoroly well advertised and meet every condition provided for in the specification under which the Barrett Mfg. Co., demands that they be constructed.

The Consolidated Expanded Metal Co's, Pittsburg and New York, send some data and plans for reinforced concrete bridges and culverts for insertion in their catalog, which include the standard designs for Pennsylvania and New York highways.

The Jennison-Wright Co., Toledo, O., send circulars of their Kreolite hexagonal and other forms of creosoted wood paving blocks for factory and bridge floors, area ways and street pavements.

Stone and Webster's annual manual of the companies under the management has been distributed.

D. B. Luten, Indianapolis, Ind., is distributing copies of the latest decision in favor of nine of his patents for reinforced concrete arches and bridges, made by the U. S. District Court for Indiana against John W. Barlow.

A story with a moral is given in "The Autobiograph of a Cement Sack," published by the Universal Portland Cement Co.

The New York Polo grounds during the world's series ball games are shown in a card advertising Medusa stainless white portland cement used in building the grand stand and the fences. A new booklet describes the successful use of Medusa waterproofing and is full of useful information.

The Long Green published periodically by the Coldwell Lawn Mower Co., Newburg, N. Y., is devoted to their gasoline motor and hand lawn mowers. It is handsomely printed and illustrated.

Rocmac Limited, Box K, Thorold, Ont., distribute a circular descriptive of their pavement, which is fitted for light traffic streets and country roads.

Refined asphalt for municipal paving plants is the subject of a pamphlet issued by the American Asphaltum and Rubber Co., Chicago, Ill., which demonstrates by comparisons of cost the economy of purchasing asphalt which is high in bitumen as are both the Gilsonite and the asphalt flux which are used in the various "Pioneer" products. The booklet is well worth reading and will be sent on request.

Dolarway pavement is fully described and illustrated in a handsome booklet which will be sent on request by the Dolarway Paving Co., Whiteball building, New York City.

The new Beale-Moore hydraulic operator for large gate valves is well illustrated in a booklet issued by the Self-Operating Valve Co., Woodward building, Washington, D. C.

C. L. Farnsworth, 33 Central street, Boston, Mass., sends a convincing letter to the effect that the success of tar concrete street crossings in New England towns in evidence that the whole street can be covered the same way at low cost for construction and maintenance using Ma-Drite.

The Kelley Island Lime & Transport Co., Cleveland, O., is distributing some handsome circulars about "Rubber-Stone," which is a road building and repairing material made by the Howe method of combining limestone screenings with deliquescent chlorides. The result of its use is the maintenance of good road surfaces at low cost. Send for the detailed information.

One of the most thoroly prepared books on road materials that has appeared is the new 100-page description of "Triangle Mesh Wire Reinforced Concrete Pavements and Roadways," issued by the American Steel and Wire Co., Chicago. It shows why reinforced concrete pavements can be and are good pavements.

The Jewell Bulletin gives full information about the Jewell Nursery Co., Lake City, Minn., which supplies park, street and shade trees as well as fruit trees and plants.